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DECEMBER 1955

VOLUME 38 • NUMBER 12

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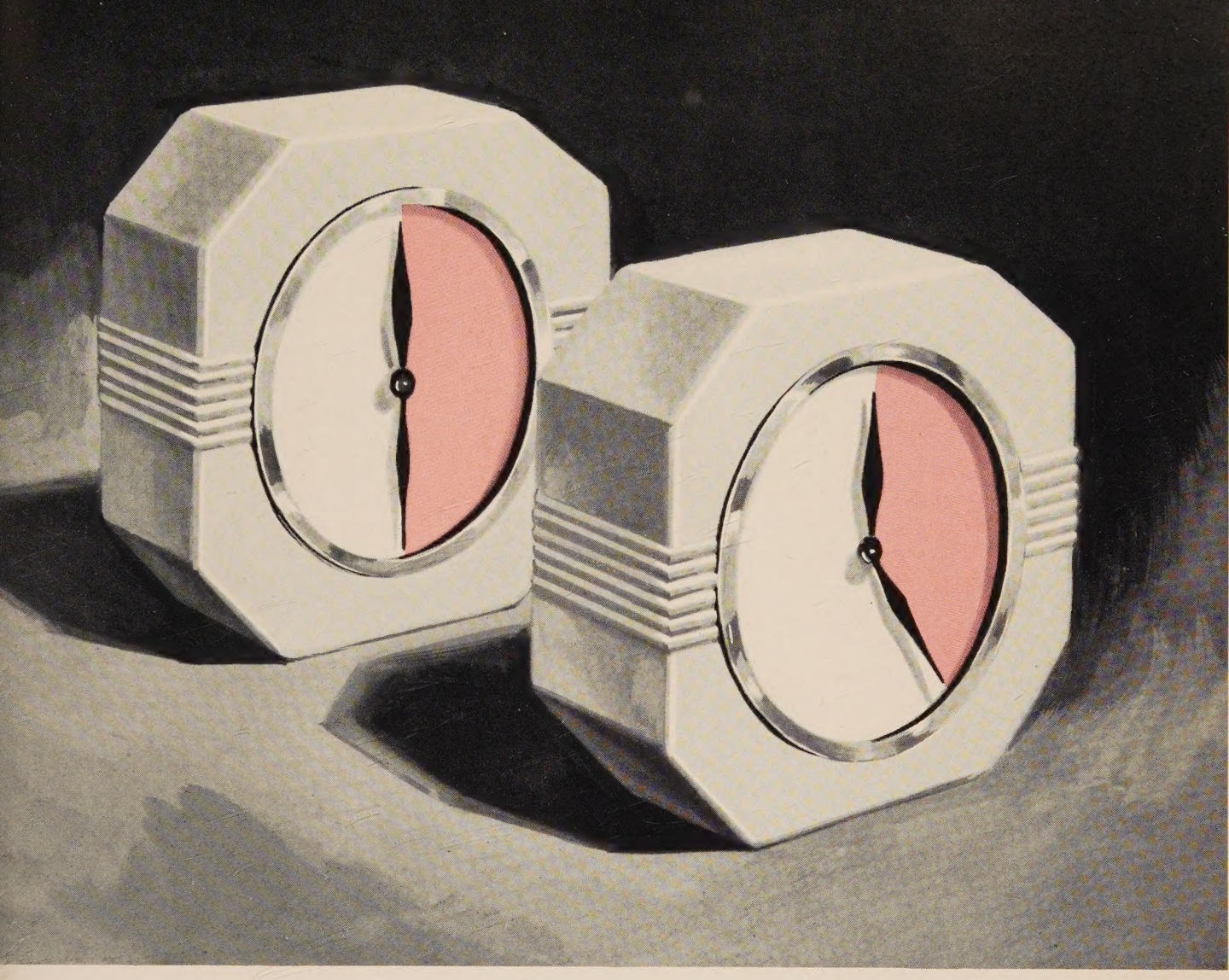

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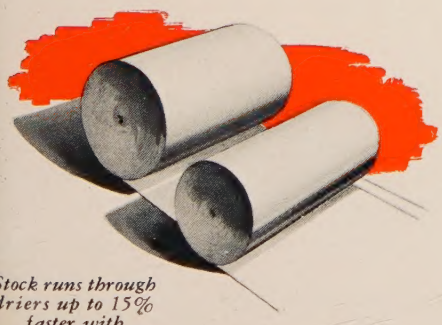

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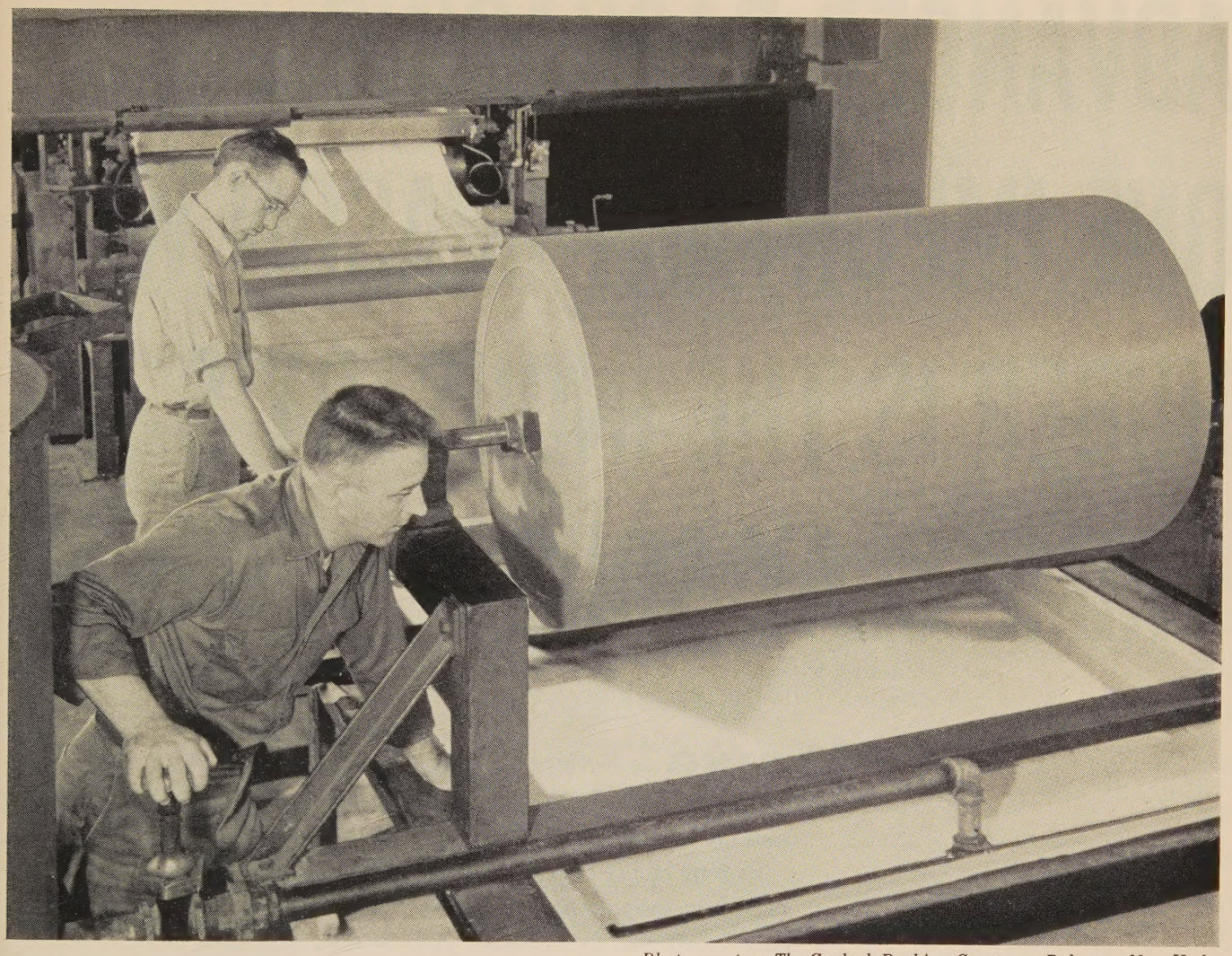

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Published monthly by the Technical Association of the Pulp and Paper Industry at 20th and Northampton Streets, Easton, Pa. Editorial and advertising offices, 155 East 44th Street, New York 17, N. Y. Articles for publication and communications regarding the editorial content of *Tappi* should be addressed to the Editor at the editorial office. Statements and opinions expressed in articles and editorials appearing in *Tappi* are those of the contributors, and the Technical Association of the Pulp and Paper Industry assumes no responsibility for them. Subscription: U. S. and possessions $7.50; Canada $8.25; Pan American Union $9.00; Other Foreign $10.00. Single copies to members of TAPPI $0.75; Nonmembers $1.00. Entered as second class matter January 27, 1949, at the Post Office at Easton, Pa., under the act of August 24, 1912. Copyright, 1955, by the Technical Association of the Pulp and Paper Industry. An index of the technical articles appearing in the magazine appears in the Industrial Arts Index and the Engineering Index.

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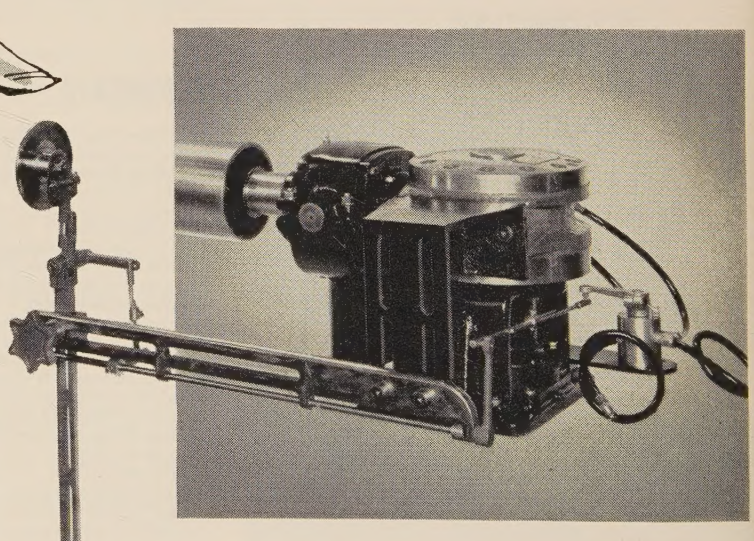

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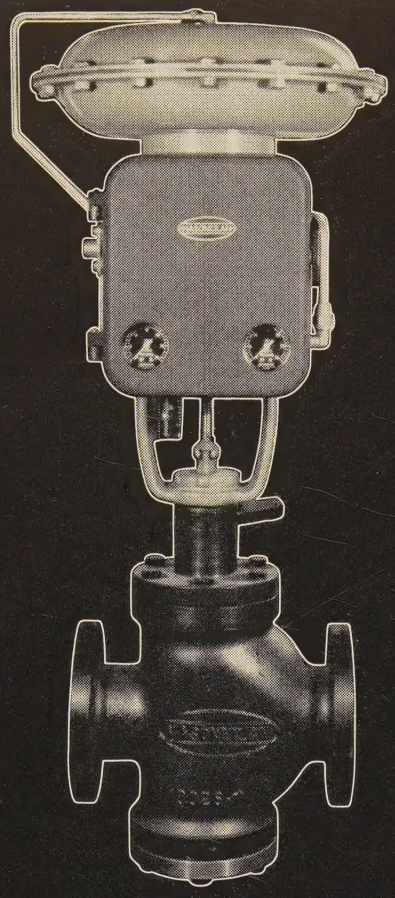

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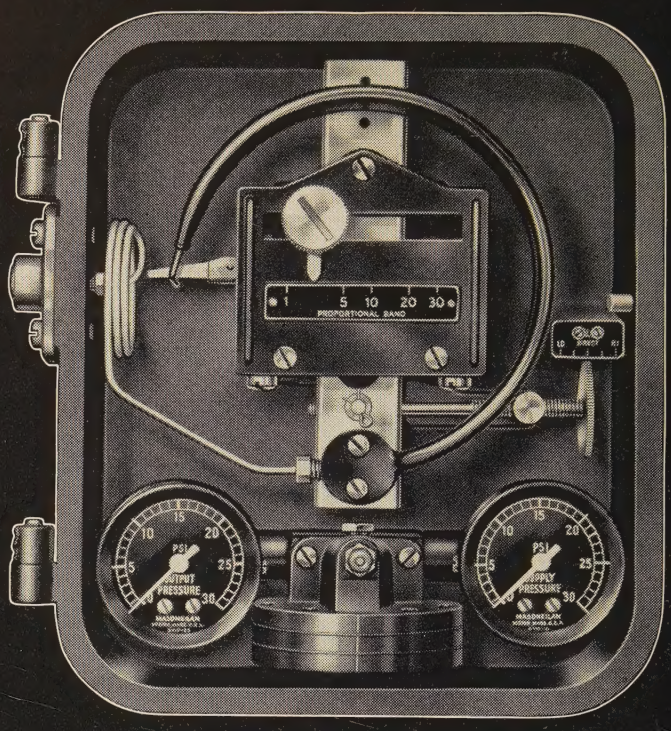

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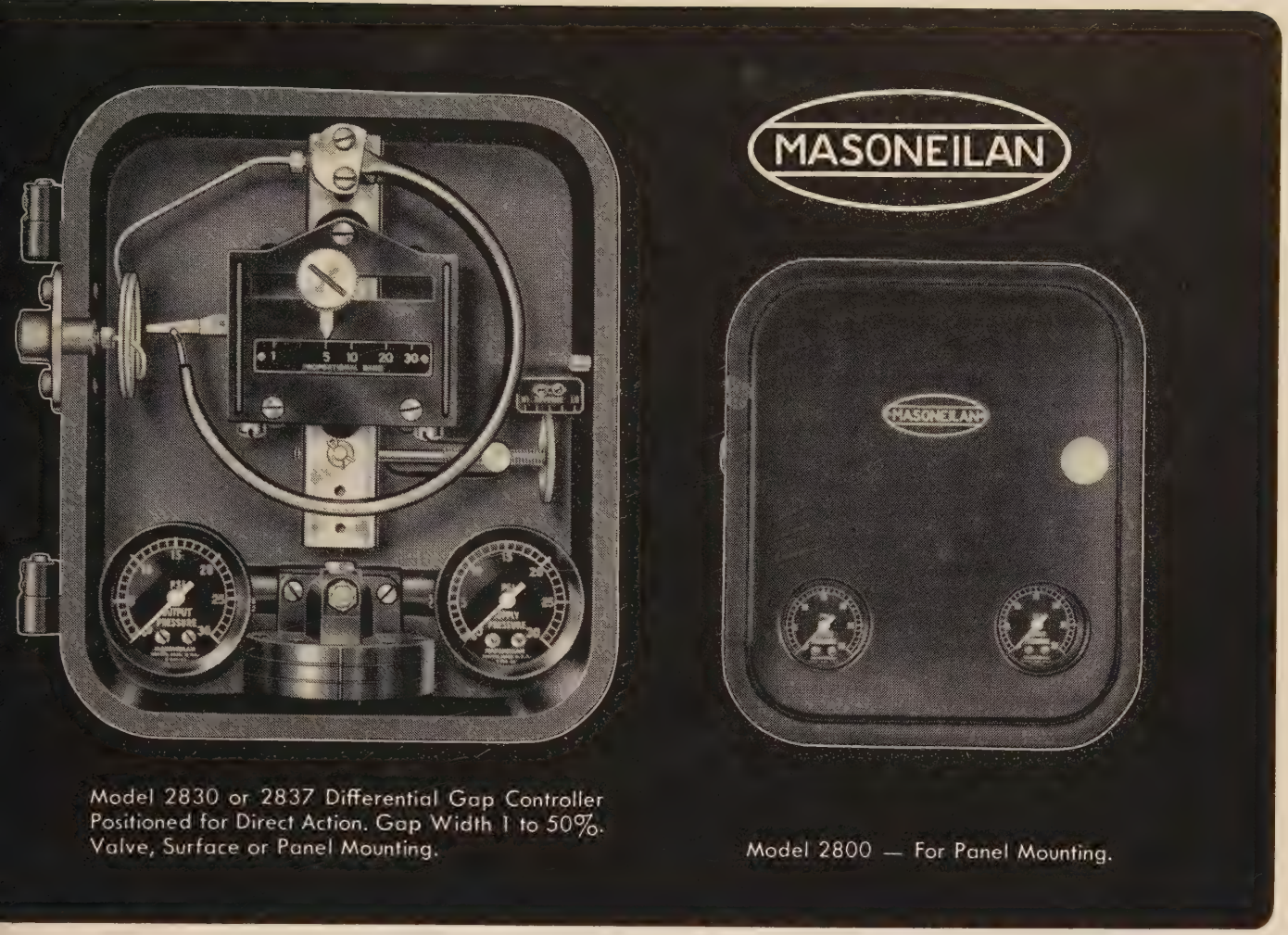

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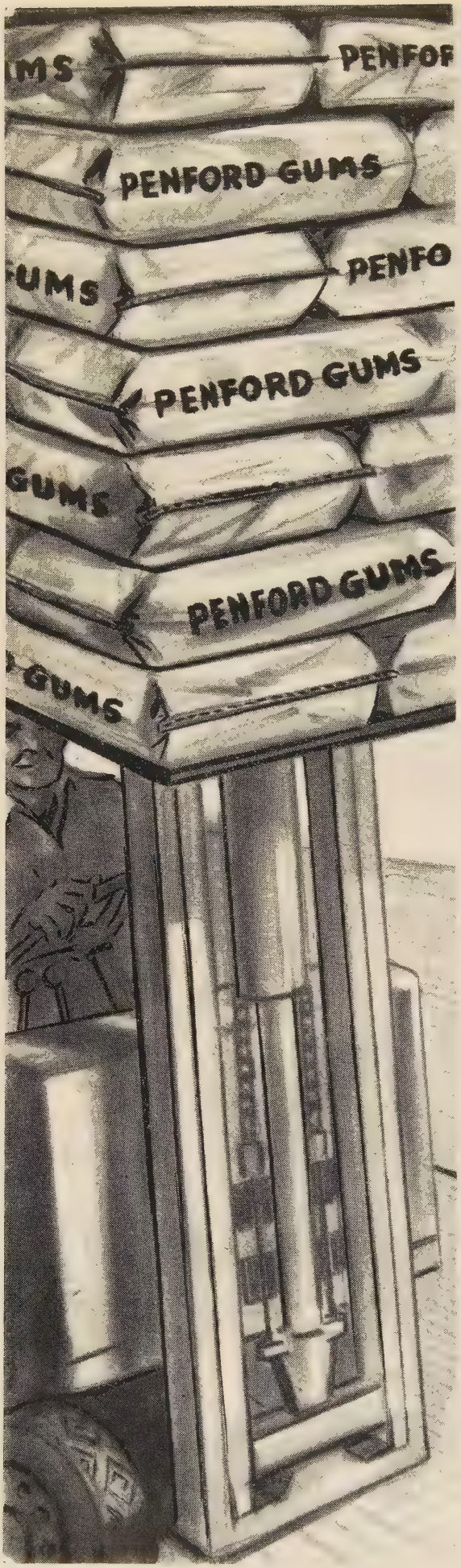

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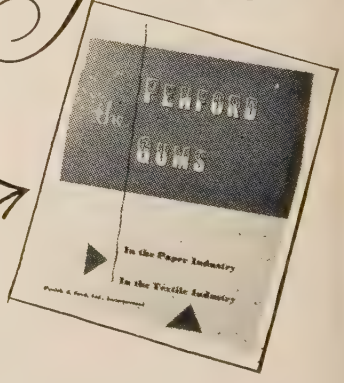

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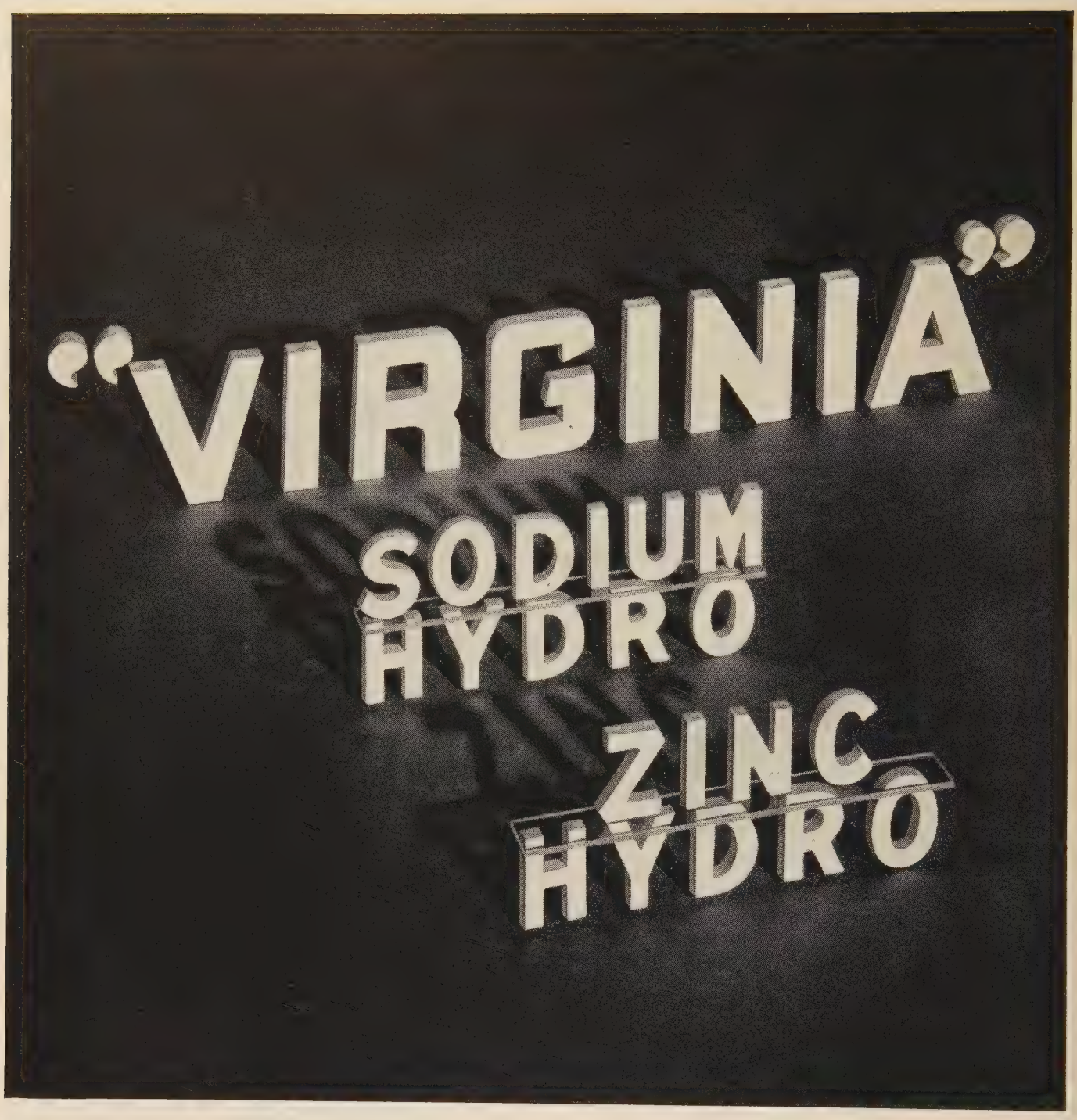

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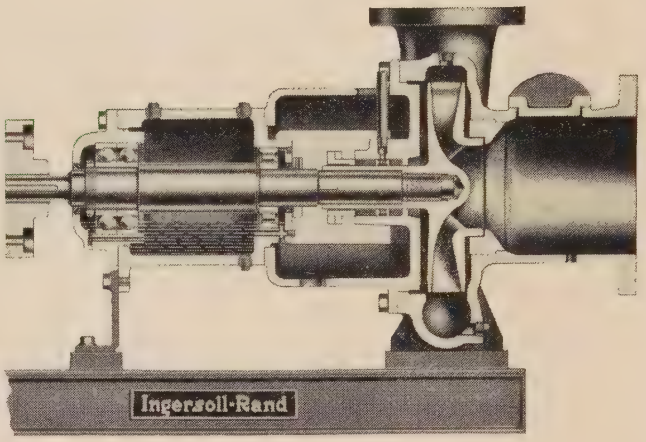

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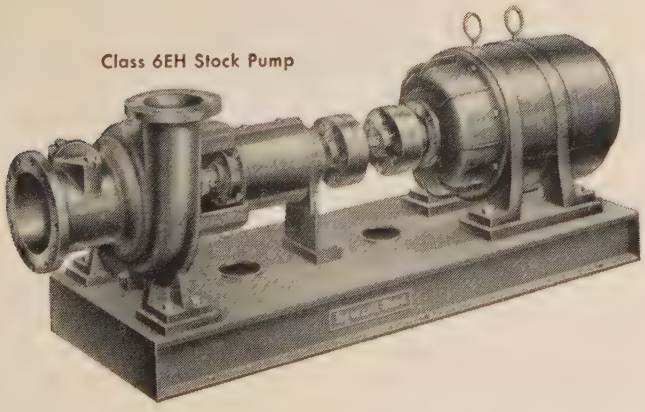

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THE TECHNICAL ASSOCIATION SECTIONS

From the beginning it has been recognized by the leaders of the Technical Association that to serve its members it is necessary to consider a regional setup. In the early days when the membership was small this need led to the holding of at least one national meeting each year in a pulp and paper center outside of New York City.

There were a few early attempts to get local organizations under way in the Miami Valley and in Holyoke. Later a group called the Paper Technologists Club was formed in the Kalamazoo Valley which later was expanded in scope and became a local section of the Association. In most cases these local groups were informal in organization and had no recognized standing in the national body.

In 1929 the Executive Committee gave serious consideration to the establishment of local sections, provided for financial assistance, and suggested a form of self government or articles of organization for such groups.

Pacific Section

For some time prior to the fall of 1928 there had been discussion about forming a Pacific Coast technical organization and in September, 1928, H. K. Benson of the Department of Chemistry and Chemical Engineering issued a call for a meeting in October at the University in Seattle. About 100 attended. The purpose of the meeting was stated to be a discussion of the cooperation of the industry with educational and research institutions.

At this meeting a resolution was passed to authorize the chairman (Mr. Benson) to invite each of the operating mills to designate a representative to serve on a committee to work out plans for future conferences of the pulp and paper industry of the Pacific Coast. In response to this request 12 men met at the New Washington Hotel in Seattle on Jan. 12, 1929, and unanimously went on record in favor of the establishment of a Pacific Section of the Technical Association, framed a resolution setting forth their view, and dispatched it to R. G. Macdonald, secretary-treasurer of the National organization.

Present at the Seattle meeting were Robert H. Scanlon and Robert Bell-Irving of the Powell River Co.; E. B. Brennan of the British Columbia Pulp & Paper Co.; F. C. Brewer, Shafer Box Co.; Ralph Reid, St. Helens Pulp & Paper Co.; Myron Black, Inland Empire Paper Co.; Robert Bundy, Fibreboard Products Co.; C. B. Everitt, Fidalgo Pulp Co.; Erik Ekholm, San Juan Pulp Manufacturing Co.; William Breitenbach, Ranier Pulp & Paper Co.; B. T. McBain, Northwestern Pulp & Paper Co., and H. K. Benson, University of Washington.

At the Annual Meeting of the Association in February, the Executive Committee instructed and authorized Secretary Macdonald to make a trip to the Pacific Coast as soon as possible to arrange for the formation of the Pacific Section.

Actual organization of the Pacific Section took place on Saturday evening, June 22, 1929, at the New Washington Hotel in Seattle, Wash. Thirty-three men took part and after hearing an outline of the work of the Technical Association by R. G. Macdonald, secretary-treasurer, elected officers to serve until the fall meeting.

The first officers of the Pacific Section were: Chairman—C. R. P. Cash, Cascade Paper Co., Tacoma, Wash.; Vice-Chairman—R. M. DeCew, Fibreboard Products, Inc., Sumner, Wash.; Secretary-Treasurer—Professor H. K. Benson, University of Washington, Seattle.

The first meeting of the section after its organization was at the Winthrop Hotel in Tacoma, Wash., on Oct. 5, 1929. P. H. Glatfelter, president of the Association and of the P. H. Glatfelter Co., Spring Grove, Pa., attended and addressed the group, stressing the work of the Association as an aid to each man in his everyday work. He urged the new section to work closely with the national body on technical matters. An election was held in which R. S. Wertheimer of the Longview Fibre Co. was elected chairman, Ralph Reid of the St. Helens Pulp & Paper Co., vice-chairman, and H. K. Benson was re-elected secretary-treasurer. Twenty-seven men were present to hear the technical paper presented.

An excellent detailed history of this section appeared in the August, 1940, issue of the *Pacific Pulp and Paper Industry*.

In September, 1934, the Pacific Section was host to the fall convention of the Technical Association at Portland, Ore. Under the able chairmanship of H. Robert Heuer of the Longview, Wash., mill of the Weyerhaeuser Timber Co., one of the greatest fall meetings of the association was arranged. About 500 men and women were present, many from the East who were making their first visit to the Pacific Coast. They were impressed with the great resources of the Northwest. The trip to the Weyerhaeuser woodlands was a highlight of the meeting.

Annual meetings in recent years have been held with the Pacific Division of the A.P.P.M. Superintendents Association. At the 1935 meeting, Albert Bankus, vice-president of the Crown Zellerbach Corp. and member of the National Executive Committee of the Association wrote in complimenting the men on holding joint meetings:

"Besides the value of working together in the individual mills, I think the program of meeting together

R. G. Macdonald and R. T. Bingham, Technical Association of the Pulp and Paper Industry, New York, N. Y.

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promises another distinct value. When the operating men who present the problems and must use the answers, meet with the technical men who study the problems and offer the answers, I feel that the meeting itself, without losing the necessary features of good fellowship and entertainment, is bound to emphasize the serious business which brings the two groups together."

In 1936, the first full year of following a policy of holding monthly regional meetings was noteworthy. These meetings were held in Portland, Seattle, Vancouver, B. C., Olympia, Everett, Tacoma, and Port Angeles. This policy has continued.

In 1939 the section announced the Shibley Award, a prize of $50 to be given to the mill man presenting a paper before the section that is judged the best from the standpoint of technical excellence, presentation, and reception by the audience. The award was named after Kenneth Shibley, water treatment engineer of Seattle who passed away in May, 1937, and who had first suggested the award. This has stimulated the presentation of papers by mill men, especially by the younger men.

In 1940 the National Association again held its fall convention on the Pacific Coast, this time at Seattle, under the able chairmanship of G. S. Brazeau of the Everett, Wash., mill of the Weyerhaeuser Timber Co. As in 1934 it was again an outstanding success both in attendance and program feature.

In 1949 the Pacific Section sponsored the last of the Association's fall meetings. Because of the growth of the Association and the difficulty in obtaining adequate accommodations for the large group that usually attended, the fall meetings were discontinued during the war. In their place the functional meeting program has developed. However, the Pacific Section had requested that the fall meeting for 1949 be held on the West Coast previous to the decision not to hold such meetings. The section wished to hold to the original plan and so held the meeting which was as successful as the previous ones.

The present officers follow:

Chairman—J. M. McEwen, Weyerhaeuser Timber Co., Everett, Wash.
Vice-Chairman—B. T. Briggs, Rayonier, Inc., Shelton, Wash.
Secretary-Treasurer—R. H. Smythe, Ray Smythe Co., Portland, Ore.
Executive Committee—Officers and H. B. Petersen, Hercules Powder Co., Portland, Ore.; K. G. Booth, Crown Zellerbach Corp., Camas, Wash.; Norval Magnusson, Puget Sound Pulp & Timber Co., Bellingham, Wash.; S. P. Strayer, St. Regis Paper Co., Tacoma, Wash.
Past-Chairmen—C. R. P. Cash, R. S. Wertheimer, C. W. Morden, R. B. Hansen, Lawrence Killam, M. W. Black, W. R. Barber, F. A. Olmsted, Carl Fahlstrom, G. H. McGregor, N. W. Coster, C. E. Braun, E. P. Wood, C. A. Enghouse, Erik Ekholm, H. W. Bialkowsky, G. H. Gallaway, J. L. McCarthy, H. C. Wall, W. F. Holzer, R. I. Thieme, E. O. Ericsson, S. E. Hazelquist, F. J. Weleber, and E. H. Nunn
National Executive Committee Representative—E. O. Ericsson, Puget Sound Pulp & Timber Co., Bellingham, Wash.

Lake States Section

The Lake States Section was organized by Otto Kress, then of The Institute of Paper Chemistry, and held its first meeting at the Menasha Hotel, Menasha, Wis., on Oct. 17, 1930.

Most of its meetings have been held monthly from October until May in the Conway Hotel, Appleton, Wis., although some meetings have been held at Madison, Wausau, Wisconsin Rapids, and Green Bay. The section has had an excellent record and has benefited considerably because of the proximity of The Institute of Paper Chemistry in Appleton and the Forest Products Laboratory in Madison. The staff of both of these institutions have contributed much through the presentation of papers and the assistance of personnel.

The officers follow:

Chairman—S. R. Parsons, Consolidated Water Power and Paper Co., Wisconsin Rapids, Wis.
Vice-Chairman—S. J. Baisch, Thilmany Pulp and Paper Co., Kaukauna, Wis.
Secretary—D. J. MacLaurin, Gilbert Paper Co., Menasha, Wis.
Treasurer—W. J. Bublitz, Kimberly-Clark Corp., Neenah, Wis.
Executive committee—Officers and L. A. Moss, Whiting Plover Paper Co., Stevens Point, Wis.; J. R. Salvesen, Marathon Corp., Rothschild, Wis.; J. W. Bard, Marathon Corp., Green Bay, Wis.; R. L. Leaf, Jr., Shawano Paper Mills, Shawano, Wis.
Past-Chairmen—G. K. Hill, Otto Kress, R. J. LeRoux, A. T. Gardner, S. D. Wells, J. R. Fanselow, H. W. Morgan, E. H. Voightman, R. A. Nugent, M. L. Downs, N. L. Malcove, J. H. Graff, T. R. Probst, J. P. Weidner, H. P. Dixson, L. V. Forman, C. J. West, Jr., A. M. Heald, G. R. Sears, H. C. Crandall, A. P. Adrian, H. W. Rowe, Robert J. Seidl, L. A. Moss
National Executive Committee Representative—J. C. Wollwage, Kimberly-Clark Corp., Neenah, Wis.

Delaware Valley Section

The Delaware Valley Section was organized in June 1931, in Philadelphia by Harvey P. Cannon, William R. Maull, C. W. Rivise, W. M. Shoemaker, and H. C. Schwalbe.

Regular meetings were started in the fall of 1932 and have been held almost continuously at the Engineers Club in Philadelphia.

The section sponsored a fall convention of the National organization at Atlantic City, N. J., in 1935, of which William R. Maull was general chairman. A number of meetings have been held jointly with the Pennsylvania–New Jersey–Delaware Division of the A.P.P.M. Superintendents Association.

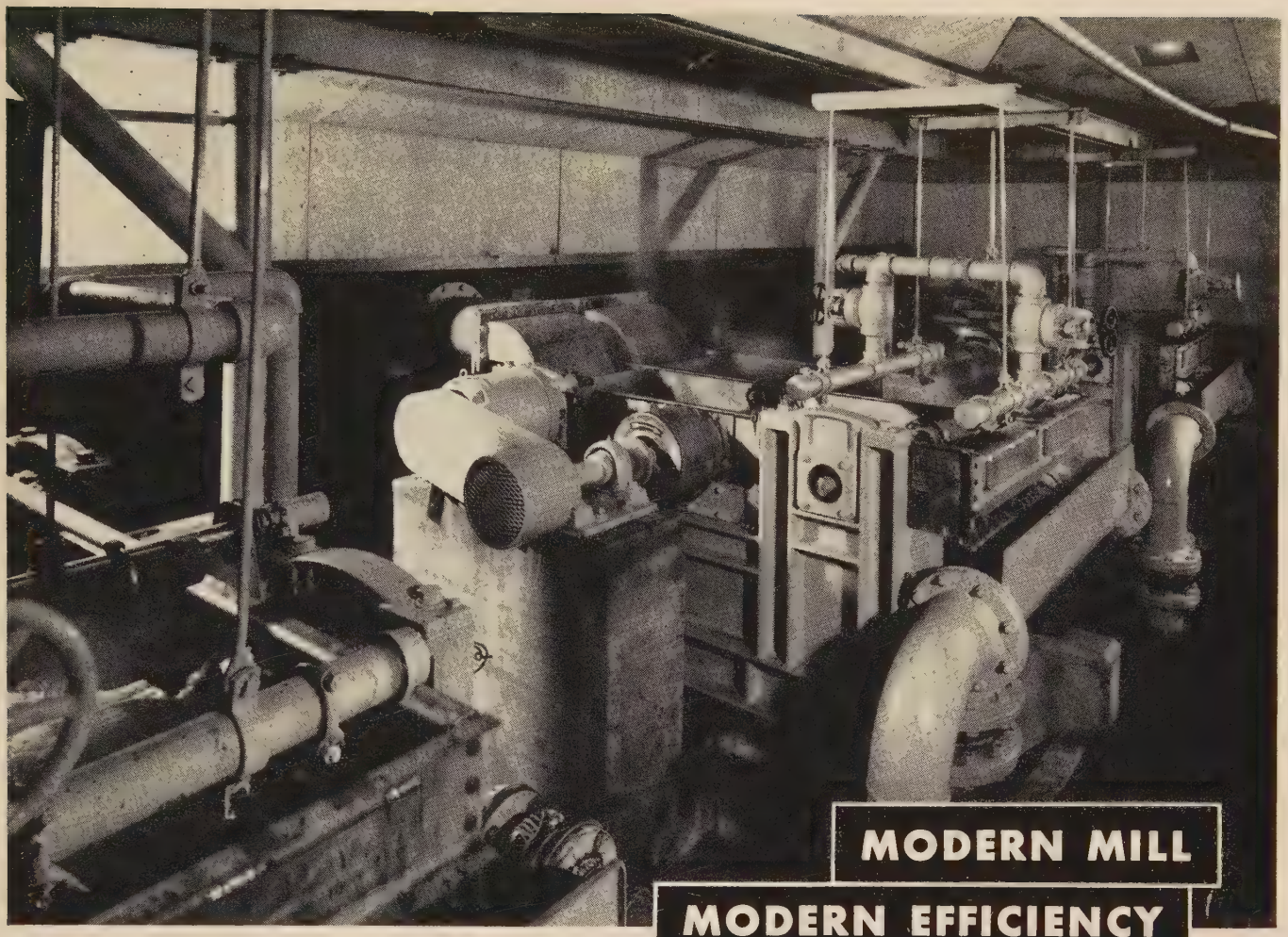
The present officers are:

Chairman—Philip E. Nethercut, Scott Paper Co., Chester, Pa.
First Vice-Chairman—C. R. Calkins, Riegel Paper Corp., Milford, N. J.
Second Vice-Chairman—C. F. Ackerman, Union Mills Paper Mfg. Co., New Hope, Pa.
Treasurer—D. C. Kane, Paper Makers Chemical Dept., Hercules Powder Co., Wilmington, Del.
Secretary—George K. Boger, Jr., Paper Products Mfg. Co., Swarthmore, Pa.
Executive Committee—Officers and Frank J. Lovegren, P. H. Glatfelter Co., Spring Grove, Pa., and Emil R. Padavic, Container Corp., of America, Manayunk, Pa.
Past-Chairmen—W. R. Maull, G. E. Landt, H. P. Cannon, H. C. Schwalbe, J. d'A. Clark, C. M. Connor, E. J. Albert, J. D. Davis, W. M. Shoemaker, A. L. M. Bixler, John Macadam, J. P. Weidner, A. S. Erspamer, H. C. Brill, F. J. Lovegren, and E. R. Padavic
National Executive Committee Representative—J. D. Lyall, Armstrong Cork Co., Lancaster, Pa.

Kalamazoo Valley Section

The Kalamazoo Valley Section was organized at Kalamazoo, Mich., on May 4, 1931, as the successor to the Paper Technologists Club which had functioned for a few years prior to this (founded in 1927).

A feature of the annual program of the section is its annual joint meeting, held with the Michigan Division of the A.P.P.M. Superintendents Association. These



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meetings were instigated by the much revered Mike Redmond of the Kalamazoo Paper Co. and Ralph A. Hayward of the Kalamazoo Vegetable Parchment Co. In addition to the regular attendants from the two local organizations a special effort is made to bring out the mill operators, machine tenders, department foremen, etc. Officers of both national organizations are present and a prominent speaker is obtained to present a subject of popular interest. "Uncle Jake" Kindleberger of K.V.P. and Mike Redmond, while they were active, added much of interest and value in their observations and remarks.

The officers are:

Chairman—R. T. Trelfa, Watervliet Paper Co., Watervliet, Mich.
Vice-Chairman—R. T. Elias, Western Michigan College, Kalamazoo, Mich.
Secretary—P. D. Applegate, Hercules Powder Co., Kalamazoo, Mich.
Treasurer—H. R. Hall, Allied Paper Mills, Kalamazoo, Mich.
Executive Committee—Officers and O. W. Callighan, Minerals & Chemicals Corporation of America, Kalamazoo, Mich.; H. L. Vanderberg, A. E. Staley Manufacturing Co., Kalamazoo, Mich.; W. E. Caldwell, St. Regis Paper Co., Kalamazoo, Mich.; N. K. Plantefaber, R. T. Vanderbilt Co., Inc., Kalamazoo, Mich.; E. E. Stephenson, Jr., Sutherland Paper Co., Kalamazoo, Mich.; C. E. Mueller, Lockport Felt Co., Kalamazoo, Mich.; and John Lean, Rex Paper Co., Kalamazoo, Mich.
Past-Chairmen—M. D. Bardeen, E. F. Whittington, H. C. Bradford, C. C. Schneider, H. M. Annis, M. R. Wilkins, W. F. Hathaway, P. de Guehery, W. A. Kirkpatrick, F. L. Chappell, F. D. Elliott, F. R. Hamilton, E. B. Taylor, R. C. Germanson, R. T. Mashburn, L. H. Mimms, P. W. Bartholomew, S. I. Kukolich, J. J. Harrison, J. R. Dam, A. T. Luey, R. H. Hurst, and J. A. Dean
National Executive Committee Representative—R. L. Davis, Scott Paper Co., Detroit, Mich.

New England Section

The New England Section of TAPPI was organized in November, 1932 and received its charter in April of the following year.

Miss Helen U. Kiely, formerly chief chemist of the American Writing Paper Co., was secretary during the early period of New England TAPPI's existence and was greatly responsible for its fine record because of her untiring and always enthusiastic leadership.

Whenever possible the section has cooperated with the Connecticut Valley Superintendents Division in having joint meetings and many fine ones have been held over the years.

The New England Section sponsored the formation of the Maine-New Hampshire group because it was felt that the distances for active participation in the present local section were too great and that there were a sufficient number of men in Maine and New Hampshire who would be interested in holding meetings more conveniently than in Western Massachusetts.

The officers are:

Chairman—G. L. Benson, St. Regis Paper Co., East Pepperill, Mass.
Vice-Chairman—C. L. Reese, Westfield River Paper Co., Russell, Mass.
Secretary-Treasurer—R. W. Ramsdell, Hercules Powder Co., Holyoke, Mass.
Executive Committee—Richard Dempsey, A. E. Staley Mfg. Co., South Hadley Falls, Mass.; P. J. Fitzpatrick, American Cyanamid Co., Boston, Mass.; C. I. Horton, Philadelphia Felt Co., Norwalk, Conn.; Miss Helen U. Kiely, American Writing Paper Co., Holyoke, Mass.; F. S. Klein, Byron Weston Co., Dalton, Mass.; John Lewis, Lowell Technological Institute, Lowell, Mass.; J. T. Loomer, Robert Gair Co., Uncasville, Conn.; Ronald Mallock, American Writing Paper Co., Holyoke, Mass.; F. L. Simons, Crane & Co., Dalton, Mass.; Wm. Stillman, Bird & Son, E. Walpole, Mass.; and E. W. Strecker, Esleek Mfg. Co., Turners Falls Mass.
Past-Chairmen—F. C. Clark, R. C. Griffin, J. B. Calkin, R. H. Doughty, N. I. Bearse, W. L. Foote, L. B. Tucker, C. H. Child, P. S. Bolton, R. J. Proctor, H. W. Knudson, and F. S. Klein
National Executive Committee Representative—N. I. Bearse, Champion-International Co., Lawrence, Mass.

Ohio Section

Early in 1934 an organizing committee consisting of J. H. Wallace, Ralph B. Roe, George H. Harvey, O. P. Gephart, J. F. Ohlson, E. C. Hendrickson, Carl D. Roess, and V. F. Waters met to ascertain the advisability of forming a local section of the Technical Association. This committee arranged a meeting of the technical men in the Miami Valley on Nov. 20, 1934.

The success of this meeting led to another which was held on April 20, 1935, in Middletown at which time the group decided to apply for a local section charter from the National organization. The first officers elected were: Chairman—Vincent F. Waters, Wrenn Paper Co.; First Vice-Chairman—J. J. O'Connor, Mead Corp.; Second Vice-Chairman—Homer H. Latimer, Beckett Paper Co.; Secretary-Treasurer—Carl D. Roess, Wrenn Paper Co., and Executive Committeeman—George H. Harvey, Gardner-Richardson Co. At this meeting Robert F. Reed of the Lithographic Technical Foundation discussed "Lithography and Paper" and George C. Munro of the Champion Paper & Fibre Co. described the General Electric Reflection Meter.

The charter was formally presented to the section by C. C. Heritage, president of the Association, at Middletown on Oct. 19, 1935, and the above officers were re-elected.

The present officers are:

Chairman—Wm. H. Aiken, Gardner Board and Carton Co. Middletown, Ohio
Vice-Chairman—Ellsworth H. Shriver, The Mead Corp., Chillicothe, Ohio
Corresponding Secretary—Frank C. Duvall, Shartle Brothers, Middletown, Ohio
Recording Secretary—Virgil Perry, Harding-Jones Paper Co., Middletown, Ohio
Treasurer—George B. Gregg, Cincinnati Gas & Electric Co., Cincinnati, Ohio
Executive Committee—Officers and H. R. Joiner, Champion Paper & Fibre Co., Hamilton, Ohio; J. L. Clouse, Oxford Miami Paper Co., West Carrollton, Ohio; C. E. Brandon, Howard Paper Mills, Inc., Dayton, Ohio; H. A. Smith, The Mead Corp., Chillicothe, Ohio; Donald F. Jenkins, Champion Paper & Fibre Co., Hamilton, Ohio; and Edward W. Petrich, Howard Paper Mills, Inc., Dayton, Ohio
Past-Chairmen—V. F. Waters, H. H. Latimer, K. P. Geohegan, J. E. Burdsell, H. C. Fisher, C. D. Roess, S. I. Olsen, D. M. Yost, P. S. Cade, Arthur Thurn, D. J. Goodman, H. A. Smith, C. E. Brandon, J. L. Clouse, and H. R. Joiner
National Executive Committee Representative—D. J. Goodman, Sorg Paper Co., Middletown, Ohio

Empire State Section

The Empire State Section began holding its meetings in 1935 and received its charter from Frederick C. Clark, president of the Association, on April 2, 1938, the presentation being made by R. G. Macdonald.

In 1943 because of the travel and housing difficulties occasioned by the war, the section was reorganized in a regional basis with meetings held in four districts (Central, Eastern, Western, and Northern with the

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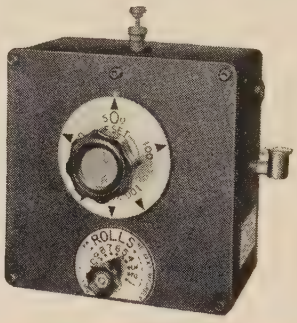

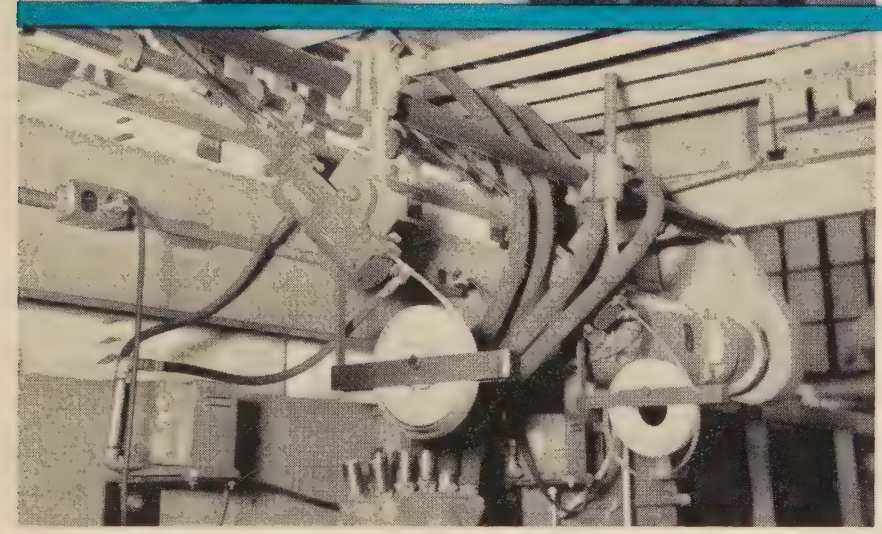

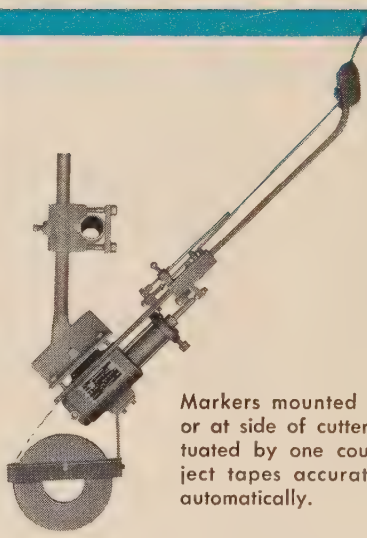

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activities centered in the neighborhoods of Syracuse, Glens Falls, Niagara Falls, and Watertown). In 1948, the Metropolitan District was added to serve the members in New York City and surrounding area.

Each district has its own officers and schedules its regular meetings. Once a year, usually in June, all the districts combine for a meeting of the Empire State Section at which time the business affairs of the section are conducted.

The officers of the Empire State Section and its various districts are:

Chairman—W. R. Willets, Titanium Pigment Co., New York, N. Y.
First Vice-Chairman—G. K. Storin, Niagara Alkali Co., Niagara Falls, N. Y.
Second Vice-Chairman—G. G. Cole, Finch, Pruyn & Co., Glens Falls, N. Y.
Third Vice-Chairman—J. W. Morrow, Newton Falls Paper Co., Newton Falls, N. Y.
Secretary-Treasurer—R. N. Prince, Fort Orange Paper Co., Castleton, N. Y.
Executive Committee—Officers and L. R. Ayers, Robert Gair Co., Piermont, N. Y.; J. J. Forsythe, International Paper Co., Niagara Falls, N. Y.; D. B. Geffken, Oswego Falls Corp., Fulton, N. Y.; E. H. Johnson, Stevens & Thompson Paper Co., Greenwich, N. Y.; and R. A. Schwartz, Knowlton Bros. Co., Watertown, N. Y.
Past-Chairmen—J. H. Schuber, C. E. Libby, J. H. Rich, R. F. Huntley, F. C. Goodwill, H. D. Cook, F. J. Lang, W. O. Hisey, F. J. McCourt, H. A. Spencer, John Campbell, M. L. Jaffe, J. E. Foote, C. E. Foster, H. J. Perry, J. S. Reichert, R. M. Drummond, D. C. Mather, and F. G. Sommerville.
National Executive Committee Representative—C. J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y.

CENTRAL DISTRICT
Chairman—D. B. Geffken, Oswego Falls Corp., Fulton, N. Y.
Vice-Chairman—W. A. Holl, Victoria Paper Mills Co., Fulton, N. Y.
Secretary—Mrs. Barbara Wortley, Solvay Process Division, Syracuse, N. Y.
Treasurer—S. E. Church, College of Forestry, State University of New York, Syracuse, N. Y.

EASTERN DISTRICT
Chairman—E. H. Johnson, Stevens & Thompson Paper Co., Greenwich, N. Y.
Vice-Chairman—Vincent Long, American Wood Board Co., Greenwich, N. Y.
Secretary—Thomas McGreen, International Paper Co., Glens Falls, N. Y.
Treasurer—Clyde Davis, Jr., Finch, Pruyn & Co., Glens Falls, N. Y.

METROPOLITAN DISTRICT
Chairman—L. R. Ayers, Robert Gair Co., Piermont, N. Y.
Chairman-Elect—J. H. Doherty, Union Bag & Paper Corp., New York, N. Y.
Secretary-Treasurer—W. A. Beeman, Socony-Vacuum Oil Co., New York, N. Y.

NORTHERN DISTRICT
Chairman—R. A. Schwartz, Knowlton Bros. Co., Watertown, N. Y.
Vice-Chairman—P. R. Anderson, St. Regis Paper Co., Deferiet, N. Y.
Secretary—Miss Elizabeth Case, Stebbins Engineering & Mfg. Co., Watertown, N. Y.
Treasurer—J. C. Parsell, J. P. Lewis Co., Beaver Falls, N. Y.

WESTERN DISTRICT
Chairman—J. J. Forsythe, International Paper Co., Niagara Falls, N. Y.
Vice-Chairman—R. H. Zinsmeister, Kimberly-Clark Corp., Niagara Falls, N. Y.
Secretary—H. E. Lindberg, Robert Gair Co., North Tonawanda, N. Y.
Treasurer—E. F. Andrews, International Paper Co., Niagara Falls, N. Y.

Maine-New Hampshire Section

Because of the area of New England and the variety of interests involved, there was considerable discussion as to the creation of a northern group to cover New

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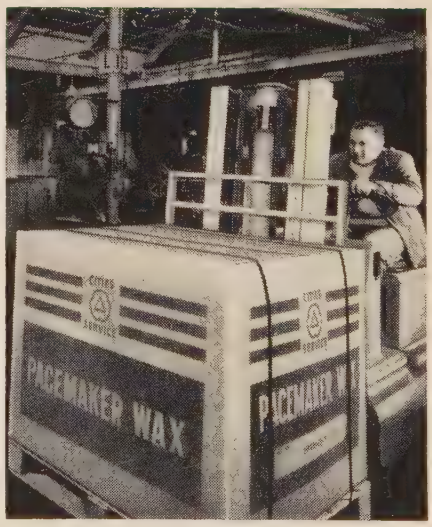

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Hampshire and Maine. Consequently, on Oct. 25, 1940, a group was organized at a meeting in Orono, Me. Worthen Brawn of the Pejepscot Paper Co. became the first chairman. The group received its charter as a section of the Technical Association at Bangor, Me., Oct. 26, 1945.

Because of the distances involved, this section has held but two meetings a year, one in the fall and one in June with a program extending to 2 days.

The officers are:

Chairman—A. E. Jones, Oxford Paper Co., Rumford, Me.
Vice-Chairman—R. J. Martin, Fraser Paper Ltd., Madawaska, Me.
Secretary-Treasurer—H. E. Pratt, Pejepscot Paper Co., Brunswick, Me.
Executive Committee—Officers and A. E. Bachmann, Missisquoi Corp., Sheldon Springs, Vt.; C. T. Bockus, Eastern Corp., Bangor, Me.; A. J. Chase, University of Maine, Orono, Me.; P. M. Goodloe, Brown Co., Berlin, N. H.; J. H. Heuer, Great Northern Paper Co., Millinocket, Me.; H. S. Hooper, Penobscot Chemical Fibre Co., Great Works, Me.; E. N. Poor, Hudson Pulp & Paper Co., Augusta, Me.; F. N. Sprague, St. Regis Paper Co., Bucksport, Me.; J. J. Thomas S. D. Warren Co., Cumberland Mills, Me.; and J. F. Wright, National Aniline Division, Boston, Mass.
Past-Chairmen—W. E. Brawn, T. M. Barry, Clifford Patch, E. L. Lamb, J. L. Parsons, G. A. Day, and J. J. Thomas
National Executive Committee Representative—J. J. Thomas, S. D. Warren Co., Cumberland Mills, Me.

Chicago Section

In October, 1943, the Chicago Professional Paper Group was organized. Because there are but few pulp or paper mills in the immediate area, most of its members were drawn from the converting and allied industries. Therefore, it was only natural that they became the sponsors of the first Corrugated Container Conference, which program has been continued very successfully.

In 1946 the group allied itself with the Technical Association and became the Chicago Section.

The officers are:

Chairman—A. C. Dreshfield, Chicago Testing Laboratory, Chicago, Ill.
Vice-President—Melvin Snover, Williamson Adhesive Co. Skokie, Ill.
Secretary—Kazuo Horita, Container Corp. of America, Chicago, Ill.
Treasurer—R. L. Ueberbacher, American Maize Products Co., Roby, Ind.
Executive Committee—Officers and R. D. Carter, Keyes Fibre Co., Hammond, Ind.; Walter C. Daley, Daley Paper Co., Chicago, Ill.; J. D. Johnson, Container Corp. of America, Chicago, Ill.; C. S. Macnair, Acme Steel Products Co., Chicago, Ill.; A. L. Magnuson, Kelco Company, Chicago, Ill.; and R. W. Porter, Fibre Containers, Chicago, Ill.
Past-Chairmen—H. R. Alley, H. E. Weston, F. D. Long, J. L. Kubicka, W. R. Price, G. A. Zinkel, A. K. Roach, V. V. Vallandigham, E. C. Berg, and J. D. Johnson.
National Executive Committee Representative—F. D. Long, Container Corp. of America, Chicago, Ill.

Lake Erie Section

On June 29, 1949, William Schoenberg wrote to the secretary and advised that there was considerable interest among the personnel in the mills located in Northern Ohio, Southeastern Michigan, and Western Pennsylvania for the formation of a section of TAPPI, since attendance at the nearest sections involved too much time for men to be away from their mills. P. S. Cade, past-chairman of the Ohio Section, advised Mr. Schoenberg to write to the secretary of the Association in regard to obtaining assistance in getting a group organized in the Cleveland area. The secretary advised Mr. Schoenberg that the simplest way to start a new local group was to plan a meeting and invite all interested to attend. With some preliminary planning this first meeting could take care of most of the organizing details.

The first meeting was called on Oct. 7, 1949, at the Hickory Grill in Cleveland and showed the results of the great enthusiasm of the steering committee. The Association secretary, R. G. Macdonald, presided during the election of officers and turned the meeting over to L. K. Burnett as first chairman of an organization called the Lake Erie Papermaker's and Converter's Association.

In the summer of 1950, a business meeting was held in Barberton, Ohio. The continued interest and enthusiasm of the organization was reflected in the serious attendance to business of the members of the executive committee and other members. Because of their efforts, a fine series of meetings were organized and when the petition reached the National Executive Committee in February, 1951, there was every evidence that the group was ready for local section status.

Consequently, on May 18, 1951, the Lake Erie Section charter was presented to L. K. Burnett by R. G. Macdonald, secretary-treasurer of the Association. Richard P. Price, vice-president of the Hammermill Paper Co., represented K. P. Geohegan, president of TAPPI, who was unable to attend because of illness.

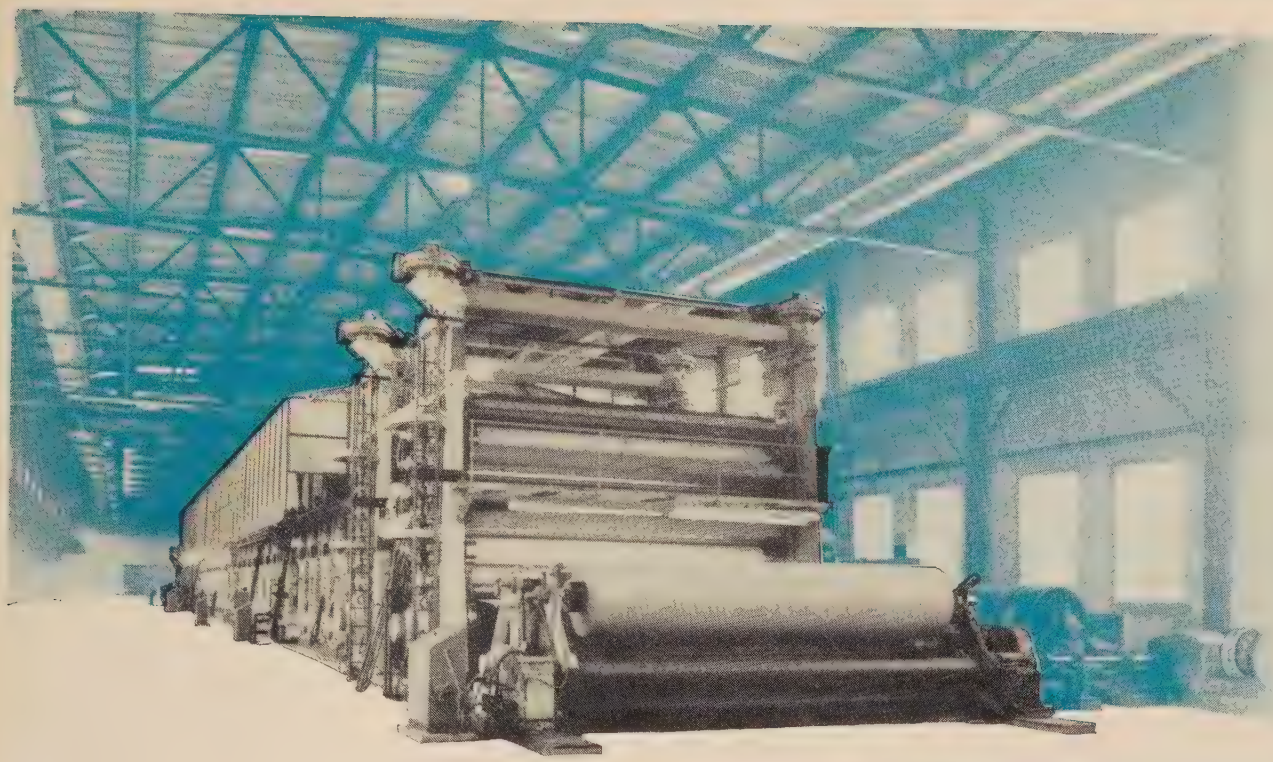
The officers are:

Chairman—Leo Gebo, Thomas Phillips Co., Akron, Ohio
First Vice-Chairman—Ted Welles, Moser Bag & Paper Co., Cleveland, Ohio
Second Vice-Chairman—C. A. Markee, The Ohio Boxboard Co., Rittman, Ohio
Treasurer—R. Mathews, Chase Bag Co., Chagrin Falls, Ohio
Secretary—Benno Beau, National Container Co., Jaite, Ohio
Financial Secretary—S. B. Gulliford, Gulliford Printing Co., Cleveland, Ohio
Executive Committee—R. L. Lewis, The Ohio Boxboard Co., Rittman, Ohio; Wm. (Bill) Schoenberg, Lord & Schoenberg, Cleveland, Ohio; Charles Daggett, Corn Products Sales Co., Cleveland, Ohio; John Preston, Federal Adhesives Corp., Cleveland, Ohio; John Richmond, The Ace Electrotype Co., Cleveland, Ohio; Marshall Veigel, National Aluminate Co., Cleveland, Ohio; Jim Krudrna, National Container Corp., Jaite, Ohio; and Dave Bechtold, Monsanto Chemical Co., Cleveland, Ohio
Past-Chairmen—L. K. Burnett, William Schoenberg, William Hasselo, R. L. Lewis, and Lloyd Shand
National Executive Committee Representative—D. J. Goodman, Sorg Paper Co., Middletown, Ohio

Southeastern Section

The first meeting of the Southeastern Pulp and Paper Society was held at the Dempsey Hotel in Macon, Ga., May 4, 1951. G. C. Kimball, Union Bag & Paper Corp., acted in the capacity of meeting chairman and introduced H. A. Kidd, resident manager of the Macon Kraft Co., who extended an invitation to the group to visit the Macon Kraft mill the following morning. R. G. Macdonald, secretary of TAPPI, was the speaker of the evening, the title of his address being "A Local Section in the Making." He mentioned that this was the second attempt to form a local group, the first being the Southern States Pulp and Paper Club which had had a short history, but provided a background of experience.

After holding several successful meetings, a charter was granted to the Southeastern Section at the King



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and Prince Hotel, St. Simons Island, Ga., on Sept. 19, 1952. R. G. Macdonald secretary of the Association, presented the charter address and the charter to the section, and talks were given by R. S. Hatch, at that time acting research director of the Hudson Pulp & Paper Co., Palatka, Fla., and G. W. E. Nicholson, vice-president, Union Bag & Paper Corp., New York, N. Y.

The officers are:

Chairman—C. N. Rogers, Sonoco Products Co., Hartsville, S. C.
Vice-Chairman—W. C. Chapman, Union Bag & Paper Corp., Savannah, Ga.
Secretary—C. L. Smith, National Container Corp., Jacksonville, Fla.
Treasurer—R. H. Homans, Brunswick Pulp & Paper Co., Brunswick, Ga.
Executive Committee—Officers and M. B. Pineo, Brunswick Pulp & Paper Co., Brunswick, Ga., and J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga.
Past-Chairmen—G. C. Kimble and M. B. Pineo
National Executive Committee Representative—J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga.

Chesapeake and Allegheny Paper Club

C. E. Libby of the North Carolina State College of Agriculture and Engineering, Raleigh, N. C., and R. G. Macdonald, secretary of TAPPI, were speakers at the organizational meeting of the Chesapeake and Allegheny Paper Club, held in Richmond, Va., Sept. 17, 1954.

J. H. Symes, National Container Corp., was chairman of the steering committee and R. B. Hobbs, National Bureau of Standards, was vice-chairman.

Since that date several meetings have been held with the object of at one day attaining section status.

The present officers are:

Chairman—J. H. Symes, National Container Corp., Big Island, Va.
Vice-Chairman—R. B. Hobbs, National Bureau of Standards, Washington, D. C.
Executive Committee—Officers and J. J. Priest, Halifax Paper Co., Roanoke Rapids, N. C.; William Jones, U. S. Department of Commerce, Washington, D. C.; and R. E. Traver, Camp Mfg. Co., Franklin, Va.

Papermakers and Associates of Southern California

The Papermakers and Associates of Southern California was organized May 15, 1941, in Los Angeles, Calif. This group has held meetings periodically since that time but it is not affiliated with the Technical Association.

The officers are:

Chairman—William Richards, Container Corp. of America, Los Angeles, Calif.
Co-Chairman—Ronald Boedeker, Container Corp. of America, Los Angeles, Calif.
Secretary-Treasurer—William Ingham, National Aniline Division, Los Angeles, Calif.
Past-Chairmen—H. L. Joachim, V. C. Farmer, C. G. Frampton, W. A. Kinney, F. H. Wheelock, R. S. Buckley, John Van Ounsem, W. G. Hartford, B. F. Brown, Jr., R. W. Stevens, Claude Sharp, W. C. Birdsey, J. T. Cooey, T. S. Markov, and A. R. Hooker, Jr.

THE TAPPI MEDAL AWARDS

One of the greatest distinctions that can come to a man in the pulp and paper industry is the award of the gold medal of the Technical Association. The candidate is selected by the Executive Committee (with not more than one dissenting vote permitted) and is given to individuals whose achievements have contributed to the technical progress of the pulp and paper industry.

Following is a brief review of the history and accomplishments of the medalists:

William H. Mason (1928)

William H. Mason was born in West Virginia and received his education at Washington and Lee University, later studying mechanical engineering at Cornell University. During the Spanish-American War he served as an ensign in the navy and then went with Thomas A. Edison for the ensuing 16 years. At the outbreak of the World War he accepted the position of general superintendent of construction for the government shipyards at Bristol, Pa., where in 11 months he built up an organization of 8000 men and completed 12 shipways as well as a large town site. After the war he did some development work for General Motors on a hydraulic transmission. In 1920 Mr. Mason went to Laurel, Miss., where he developed a process for extracting naval stores from lumber during the course of manufacture. Four of these plants were built and are now in successful operation. Mr. Mason then turned his attention to the possibility of exploding wood fiber with high-pressure steam and after a prolonged series of experiments worked out the methods which now form the basis of operation in the Masonite Corp.'s plant. The value of such a process for converting wood refuse into high grade substitutes and supplements for lumber cannot be overestimated in these days when the necessity for full utilization of our forests is being appreciated. As an engineering contribution, Mr. Mason's pioneer work in this new method of defibering stands out in the pulp and paper industry.

Ogden Minton (1928)

Ogden Minton's career and achievements exemplify the fact that outstanding developments are generally the combination of a thoroughly trained mind, a practical understanding of the goal to be reached, unlimited confidence in ultimate success, and a tremendous amount of hard work. Mr. Minton was born in Brooklyn in 1885 and was educated in the Brooklyn Polytechnic Preparatory School, and like Mr. Mason was later graduated from Cornell University. After a number of years' experience in engineering and financial matters, Mr. Minton went into the engineering department of the American Writing Paper Co. at Holyoke, Mass. He then served as a Captain of Ordnance during the World War, after which he spent a year recuperating from a severe attack of influenza. It was then that Mr. Minton decided to turn his full efforts to developing the vacuum drier, an idea first conceived in 1914 and patented in 1915. He gathered around him a small staff of technical men who subsequently devoted almost 5 years to thermodynamic and engineering studies in order to design and build full-size driers. The first ones were installed for the Armstrong Cork Co., the Bakelite Corp., and Price Bros. & Co. Ltd.

Ernst Mahler (1933)

The medal award in 1933 went to Ernst Mahler, vice-president of the Kimberly-Clark Corp., Neenah, Wis. The award was made during the fall meeting of

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the Association held at Appleton, Wis., on Sept. 27, 1933. Mr. Mahler is a graduate of the Technische Hochshule at Darmstadt, Germany, and came to the United States in 1910 to represent the Badische Co. as a dyestuff expert. In 1914 he became associated with the Kimberly-Clark Corp. Among his contributions to progress are the following: the development of a bleached groundwood sheet used in the manufacture of book, magazine, rotogravure, and other printing papers; the development of cellucotton; aid in the development of a forced circulation system for sulphite cooking; the development of the Niagara beater. He also brought equipment and processes from Germany, such as the Voith inlet, the screw press, and improved pulp screen. In 1915, he helped to organize the Technical Association of the Pulp and Paper Industry and he is the founder of The Institute of Paper Chemistry.

Edwin Sutermeister (1935)

The fourth individual to receive the medal was Edwin Sutermeister, chief chemist of S. D. Warren Co., Cumberland Mills, Me. Mr. Sutermeister was born in Milton, Mass., and was graduated from the Massachusetts Institute of Technology in 1899. He was employed as a chemist in the U. S. Forest Service in Washington, D. C., and Madison, Wis., from 1907 to 1910. With the exception of these years, he has been with S. D. Warren since 1899. The medalist is probably most widely known as the author of "The Chemistry of Pulp and Paper Making," a book published by John Wiley & Co., which has run into three large editions. He is also the author of one of the American Chemical Society Monographs "Casein and its Industrial Applications." He was the originator of the pebble mill test for evaluating paper pulp. The great improvement in wood pulp during the past 20 years may be largely attributed to the testing work done by consumers of pulp. His other particular technical interests include the development and introduction of domestic clays for loading and coating of paper, the development of starches and gums for coated paper work, improvements in soda pulping, and size manufacture and application.

William H. Millspaugh (1936)

William H. Millspaugh was born in 1869 and had his first dealings with the paper industry in 1895 while a salesman for the Deming Pump Co. of Salem, Ohio. His first invention for the paper industry was a paper machine shower pipe that economized in the use of water. In 1902, he organized the Sandusky Foundry & Machine Co. In 1906, he designed an improved suction roll and subsequently developed one of outstanding success for use as a couch roll, to be used with a continuous flow rotary pump of the cycloidal type or the equivalent. This made high speeds for paper machines possible. Next followed the suction press roll. His development of a method for making castings centrifugally was a contribution to the metallurgical field. Finally his invention of a vacuum forming paper machine proved to be a success. This brought together most of his inventions, many of which dealt with details in suction roll design and construction and with many paper machine parts.

Clarence J. West (1937)

Clarence J. West was born at Brighton, Mich., in 1886 and received his doctorate from the University of Michigan in 1912. At his death he was editor of publications of The Institute of Paper Chemistry, Appleton, Wis. Dr. West is best known in the paper industry for his outstanding work in the preparation of bibliographies of the pulp and paper literature. His bibliographies in bound volumes cover the period from 1900 to 1953. He published more than 550 books, articles, translations, book reviews, etc. During the World War he was a Lieut. Colonel in the Chemical Warfare Service and was a collaborator in writing the first book on the subject. His first contact with the paper industry was made in 1919 when he was director of the information service of Arthur D. Little, Inc. From 1920 he was assistant editor of the Organic Section of *Chemical Abstracts*. In a similar capacity with the National Research Council he was editor of the *International Critical Tables* and the *Annual Survey of American Chemistry*. He was associated with the committee appointed by the National Bureau of Standards in 1921 to prepare a book on the classification and definitions of paper, and from 1920 to the time of his death he was chairman of the TAPPI Abstracts and Bibliography Committee.

Carl B. Thorne (1938)

Carl B. Thorne was born at Moss, Norway, and studied both mechanical and chemical engineering at Hanover and Dresden Universities in Germany. On leaving the university he immediately became associated with sulphite pulp manufacture and worked for a number of years as both chemist and engineer in various sulphite mills in Germany and Norway. In 1902 he came to this continent to study the manufacture of paper and in the following year joined the staff of the Riordon Co. as engineer and sulphite expert for their mills at Hawkesbury and Merritton. He was appointed manager of the Hawkesbury mill in 1905, and later also took over the management of the Merritton mill. He designed and erected in Hawkesbury the first reinforced concrete towers for the manufacture of sulphurous acid. These towers known as "Jenssen acid towers" are now generally accepted, and are used in all parts of the world. Other developments and contributions to the sulphite industry followed quickly, some of which are a sulphur dioxide reclaiming system, a radically new and different type of log barking machine which effectively removed the bark from logs of any length up to 16 ft. or even longer. Perhaps his more important contribution to the pulp industry is his continuous and multiple stage bleaching systems.

J. Newell Stephenson (1939)

J. Newell Stephenson was born in New Rochelle, N. Y., in 1882 and graduated from the Massachusetts Institute of Technology in 1909. From 1910 to 1913, he was on the faculty of the Rose Polytechnic Institute and was one of the organizers of the pulp and paper course of the University of Maine where he taught from 1913 to 1916. Since 1917, he has been editor of the *Pulp and Paper Magazine of Canada* and of the textbooks, "The Manufacture of Pulp and Paper," published by the McGraw-Hill Book Co., under the super-

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vision of the Joint Textbook Committee of the Technical Section of the Canadian Pulp and Paper Association and the Technical Association of the Pulp and Paper Industry. Since 1922, he has been principal of the Institute of Industrial Arts, Gardenvale, P. Q., and has been a contributor to the technical literature of the pulp and paper industry.

Otto Kress (1940)

The ninth medal award went to Otto Kress. Dr. Kress received his doctorate of philosophy from Columbia University in 1909 and had previously received the Illig medal from Columbia. Following this he spent a few years with the Badische Co., and during the World War became chief of the Pulp and Paper Section of the Forest Products Laboratory, Madison, Wis. This was followed by association with the Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis., E. I. du Pont de Nemours & Co., Wilmington, Del., Thilmany Pulp & Paper Co., Kaukauna, Wis., private consultant practice, and in 1929 became technical director of The Institute of Paper Chemistry, Appleton, Wis. Dr. Kress has published more than 50 technical articles and has been granted many patents for inventions in the pulp and paper industry.

Robert B. Wolf (1942)

Robert Bunson Wolf received the tenth medal award. Mr. Wolf graduated in mechanical and electrical engineering from the University of Delaware and immediately entered the paper industry, working in mills in New York and New England, eventually becoming superintendent of the Piercefield mill of the International Paper Co. When the Union Bag & Paper Corp. decided to build a pulp mill at Hudson Falls, N. Y., Mr. Wolf was employed to design and supervise the building of it and later to operate it. Following this he moved to Berlin, N. H., as manager of the mill of the Burgess Sulphite Fibre Co. Here he developed scientific methods of manufacturing and means of evaluating qualitative and quantitative variables in the manufacturing processes. Mr. Wolf contributed many papers on the subjects of nonfinancial incentives for workmen. In 1917 he became manager of the Spanish River Pulp & Paper Mills in Canada and during World War I he was a staff assistant to the Director General of the U. S. Emergency Fleet Corp. Mr. Wolf was a pioneer in the use of strong acid in sulphite making and obtained many patents covering the use of high pressure and refrigeration in acid making. He also pioneered in the bleaching of pulp at high consistency and was a pioneer in the development of functionalized cost accounting methods in the industry. He was one of the original group that founded the Technical Association of the Pulp and Paper Industry.

Harry Fletcher (1943)

The eleventh medal was awarded to Harry Fletcher, president of the Fletcher Paper Co., Alpena, Mich., who was one of the principal founders of the Technical Association of the Pulp and Paper Industry. Mr. Fletcher graduated as a chemical engineer from the University of Michigan in 1907 and immediately went to work for the Fletcher Paper Co. He is identified with the development of the high-density bleacher and was a pioneer in presenting the modern concepts of paper mill cost accounting.

D. Clark Everest (1944)

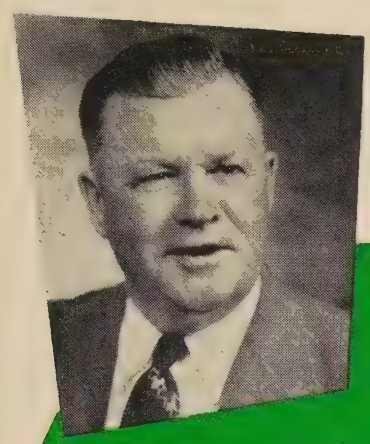
The twelfth medal was awarded to David Clark Everest, president and general manager of the Marathon Paper Mills Co., Rothschild, Wis. Mr. Everest was born in Pine Grove, Mich., Oct. 13, 1883. He entered the employ of the Bryant Paper Co., Kalamazoo Mich., as a clerk in 1900, and was assistant manager of the Munising Paper Co., Munising, Mich., from 1902 to 1907. He was a manager of the Williams-Grey Co., Chicago, Ill., from 1907 to 1909. On March 1, 1909, he went to Wausau, Wis., as manager of the newly organized Marathon Paper Mills Co., where he had charge of the construction of the Marathon mills at Rothschild, Wis. He was connected with the organization of several paper companies and a number of other manufacturing companies, including the Masonite Corp. at Laurel, Miss. He was twice president of the American Paper and Pulp Association and was one of the organizers of The Institute of Paper Chemistry at Appleton, Wis., and was a trustee and officer since its inception. From September, 1940, to October, 1941, he was chief consultant to the pulp and paper branch of the Office of Production Management, the forerunner of the War Production Board and was interested in the Technical Association of the Pulp and Paper Industry since its organization in 1915 and had served as a member of its executive committee.

Bourdon W. Scribner (1945)

The thirteenth medal was awarded to Bourdon W. Scribner, chief of the Paper Section, National Bureau of Standards, Washington, D. C. Mr. Scribner was born in Ridgeway, Pa., and received his B. S. in chemistry from Pennsylvania State College, following which he was with the West Virginia Pulp & Paper Co. for 13 years where he was employed in research and technical control. He became chief of the Paper Section of the National Bureau of Standards in 1923. At the Bureau he directed researches dealing with papermaking problems, improvements of offset printing, preservation of records, standardization of paper and paper testing methods, and the development of testing procedures and instruments. He became chairman of the TAPPI Paper Testing Committee in 1925 and initiated systematic development and adoption of testing standards by the Association. For many years he was active in the development of the Federal Specifications for paper and paper products as chairman of the Committee for Federal Specifications. The aggressive pioneer work of Mr. Scribner and his associates in developing the basic testing methods for paper did much to bring about the ever increasing quality of paper and paperboard manufactured by the industry and converted into useful paper products.

William G. MacNaughton (1946)

The fourteenth medal was awarded to William G. MacNaughton, engineer, News Print Service Bureau, New York, N. Y. Mr. MacNaughton was born in 1874 in Hinchinbrooke, Huntingdon County, Quebec, and received his B.S. degree in organic chemistry from McGill University in 1904. At McGill he also re-



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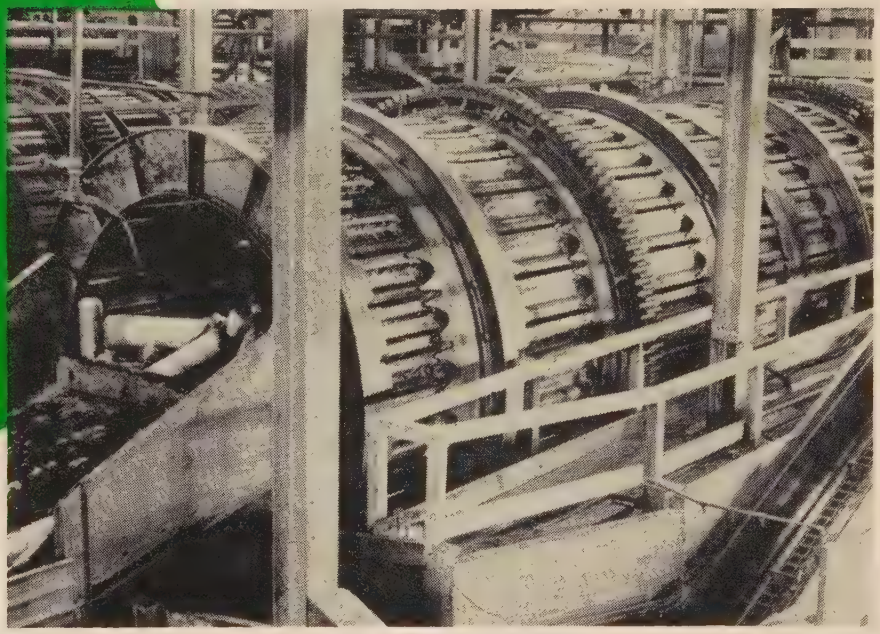

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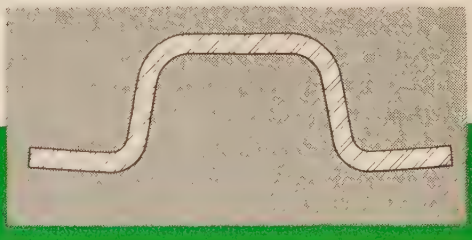
FIG. 1

FIG. 2

FIG. 3



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ceived the W. E. Logan medal in natural sciences. After graduation he worked as a chemist for the Canadian Rubber Co. in Montreal. In 1908 he joined the technical organization of the Nekoosa-Edwards Paper Co., Port Edwards, Wis. During this period he was one of the small group that organized the Technical Association of the Pulp and Paper Industry in 1915, and was an advisor to the groundwood research laboratory of Forest Products at Wausau, Wis. From 1917 to 1920 he was vice-president and manager of the Inland Empire Paper Co., at Millwood, Wash. In 1920–21 he was associated with the development of the Spruce Falls Paper & Power Co. at Kapuskasing, Ont., and in 1921 was elected secretary-treasurer of the Technical Association of the Pulp and Paper Industry in which position he remained until the end of 1927 when he became engineer for the News Print Service Bureau. From 1929 to 1933 he was an executive of the manufacturing department of the International Paper Co. in New York, following which from 1933 to 1936 he was assistant director of the Savannah Pulp and Paper Laboratory where he was associated with Charles H. Herty in developing the process of making newsprint and white papers from the southern pines. This work led to the establishment of the first newsprint mill in the south at Lufkin, Texas. In 1936 he returned to the News Print Service Bureau. Throughout his career Mr. MacNaughton was outstanding in his effort to improve opportunities in the industry. He served the Technical Association in many constructive ways from the time it was founded and was associated with the preparation of the textbooks on the Manufacture of Pulp and Paper through the first three revisions.

Peter J. Massey (1947)

The fifteenth medal was awarded to Peter J. Massey, general manager of the Bryant Division, St. Regis Paper Co., Kalamazoo, Mich. Mr. Massey was born at Jacksonville, Fla., on June 29, 1883. He attended evening classes at the Armour Institute of Technology in 1914. He was pressroom superintendent for the Butterick Publishing Co., New York, N. Y., from 1904 to 1913. From 1913 to 1929 and from 1935 to 1936 he was manager of the W. F. Hall Printing Co., Chicago, Ill. From 1929 to 1935 he was executive vice-president of the Seaman Paper Co., Chicago, Ill. From 1936 to 1940 he was general manager of the Combined Locks Paper Co., and from 1940 to 1946 was assistant to the president of the H. P. Smith Paper Co. in Chicago. In 1932 Mr. Massey was sent to Europe to make a study of papermaking and offset printing. In 1933 through research work conducted at the Bryant Paper Co., he demonstrated the practicability of coating paper on the paper machine. These advances led to further work at the Consolidated Water Power & Paper Co. at Wisconsin Rapids, Wis., resulting in the Massey patents for the high speed paper machine coating process.

Emil Heuser (1948)

The sixteenth medal was awarded to Emil Heuser. Dr. Heuser was born at Stralsund, Germany, on Sept. 15, 1882, and received his doctorate in engineering from the Technical University, Karlsruhe, Germany in 1908. From 1908 to 1912 he was chemist for several German pulp and paper mills. From 1912 to 1923 he was professor of cellulose chemistry at the Technical University, Darmstadt, Germay. From 1923 to 1926 he was director of the research department, Vereinigte Glaazstoff-Fabriken, A.G., Berlin, Germany. In 1926 he became manager of the research department of the Riordan Pulp Corp., Ltd., Hawkesbury, Ont. (Now Canadian International Paper Co.). In 1938 he joined the staff of The Institute of Paper Chemistry, Appleton, Wis., as professor of cellulose chemistry. Dr. Heuser's contributions to the technical advancement of the industry can be summarized by the friendly nickname conferred upon him by the J.I.E.C.—"Mr. Cellulose." His studies over the years were devoted largely to the chemistry of cellulose. He authored many books and articles on this complicated subject. His research efforts enabled him to solve many of the problems of pulp purification, particularly the development of a wood pulp that would meet the exacting demands of the rayon industry.

Hardy S. Ferguson (1949)

The seventeenth medal was awarded to Hardy S. Ferguson, consulting engineer and architect, New York City. Mr. Ferguson was born in 1868 and graduated from Dartmouth College and in 1891 from the Thayer School of Civil Engineering, connected with Dartmouth College. He has been in engineering practice since 1891, connected with the design and construction of pulp and paper mills, and of water power developments and hydroelectric power plants. One of his first big jobs was the building of the Great Northern paper mill at Millinocket, Me., completed in 1899. It was here that he developed the first continuous drum barker that was used in the United States. He has been closely connected with the development of the paper machine, particularly respecting speed increases from 300 to 1500 f.p.m. Once only has he ever patented any of his ideas, and in this case contributed it to the improvement of the art. In addition to the mill of the Great Northern Paper Co. he has designed mills for the Brown Co., Union Bag & Paper Corp., Jonquiere Pulp Co., Hollingsworth & Whitney Co., St. Lawrence Pulp & Lumber Co., Penobscot Chemical Fibre Co., Bedford Pulp & Paper Co., St. Maurice Paper Co., Oxford Paper Co., Ha Ha Bay Sulphite Co., Fraser Cos., Ltd., Riordan Pulp & Paper Co., Gilman Paper Co., Cushnoc Paper Co., Brompton Pulp & Paper Co., Backus-Brooks Co., Bathurst Co., Beaver Wood & Fibre Co., Chicago Mill & Lumber Co., James Maclaren Co., Soundview Pulp Co., Crossett Paper Mills and others, not including many miscellaneous engineering projects connected with power developments and mill improvements and extensions.

George H. Mead (1950)

The eighteenth TAPPI Medal was awarded to George Houk Mead, honorary chairman of the board of The Mead Corp., Chillicothe, Ohio. Among Mr. Mead's contributions to the technical advancement of the pulp and paper industry, for which the medal was awarded, are the following: (1) development of the viscose rayon pulp process with Arthur D. Little, Inc.; (2) paper machine coating: during the first World War, Mr. Mead felt that paper should be coated on the paper

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Mill Applications of Cyanamid's Paper Chemicals...

Size costs cut 16%. That's what a northern board mill reported recently when they switched from regular rosin size to CYFOR® Fortified Rosin Size. The mill found that with the switch, size consumption was reduced one third. Savings in freight are plus advantages not included in the 16% savings.

* * *

Dye costs drop one third. When a western mill started using small amounts of ACCOCEL® 741 Dispersant as a mordant in bleached stock, it was found that only two thirds of the basic dye was required. More even color throughout the sheet was another important gain.

* * *

Rewinding production boosted 50%. In running butchers' wrap, a southern mill was troubled with "skidding" or slipping of the paper when rewinding into small rolls. Then ALWAX* 251-S Wax Size was tried. When the size was added properly at the beater at the rate of 6 pounds of size solids per ton of paper, the machine ran trouble-free and rewinding speed was upped 50%.

* * *

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machine. Processes were developed and put into operation at Chillicothe wherein coating was applied without brushes to paper and dried on the paper machine driers; (3) chestnut corrugating board: although the semichemical pulping process was developed at the Forest Products Laboratory the commercial application was directed by Mr. Mead who built five mills in the central south to utilize spent chestnut chips which previously had been burned as fuel. These mills manufactured 350 tons of paperboard per day; and (4) use of calcium carbonate and calcium magnesium carbonate, waste material in the soda pulp mills, as a paper filler: The original patents for this process were held by the Raffold Co. of America; the use of these materials as a paper filler was developed by the Mead Corp. on Mr. Mead's initiative. George Houk Mead was born Nov. 5, 1877. In 1900 he graduated from M.I.T. with the degree of B.S. in Chemical Engineering. Following his graduation from M.I.T. he went to work for the Cellulose Products Co. in Boston in order that he might be under the supervision of A. D. Little, one of the leading pulp and paper chemists of the time. Little was working on the development of viscose products and the first rayon produced in the United States was made in his laboratory in Boston. He undertook the reorganization of the Mead Paper Co., serving as vice-president and general manager from 1905 to 1912, and as president from 1912 to 1942. George Mead's interests in pulp and paper have not been confined solely to the United States. In 1911, in association with Colonel H. E. Talbott, he organized the Lake Superior Paper Co. with a capitalization of $10,000,000. As vice-president and general manager of this company he entered the newsprint industry of Canada. Lake Superior Pulp and Paper Co. erected a mill at Sault Ste. Marie, Ont., which, along with his other activities he operated until 1913, when it was consolidated with the Spanish River Pulp & Paper Mills Ltd. In 1914 Mr. Mead was asked to become vice-president of the Spanish River Co., and in 1915 was elected its president, which office he held until 1928. During this period, the company doubled in size and four other properties were developed in Canada under Mead's leadership—Fort William Paper Co., at Fort William, Manitoba Paper Co., near Winnipeg, Ste. Anne Paper Co., at Ste. Anne, and the Murray Bay Paper Co. at Murray Bay, Que. In 1928 these four companies and the Spanish River Co. were merged with the Abitibi Power and Paper Co., Ltd. to form the largest producer of newsprint in the world. The daily capacity of the Abitibi mills was over 2000 tons. In 1930 The Mead Corp. was organized. This was the successor company to the Mead Pulp & Paper Co. By this time, in addition to the mills at Chillicothe and Kingsport there were properties at Lynchburg, Va., Sylva, N. C., and Harriman and Knoxville, Tenn. In order to devote more of his attention to this new group of mills, Mr. Mead relinquished active participation in the affairs of the Abitibi Co. although continuing for some years as chairman of the board. Mr. Mead served as chairman of the board of The Mead Corp. from 1942 until 1947. In 1947 when the corporation was starting in its second century of operations, and having devoted 50 years of his life to its affairs, Mr. Mead resigned as chairman of the board, and accepted the position of honorary chairman of the board, which he still retains.

George H. Tomlinson (1951)

The nineteenth TAPPI Medal was awarded to George H. Tomlinson, vice-president and director of the Howard Smith Paper Mills Ltd., and Aborite Company Ltd., of Montreal, Que. Mr. Tomlinson was born in Toronto, Ont., on June 19, 1880, the son of R. H. and Julia Tomlinson. He was educated at Upper Canada College and Trinity University in Toronto, graduating from the latter in 1901.

Prior to joining the Howard Smith organization, in 1924, Mr. Tomlinson was employed by the Lake Superior Power Co. and the Liquid Carbonic Co. In 1909 he undertook the development of a process for making ethyl alcohol from wood waste. This led to the establishment of plants at Georgetown, S. C., and Fullerton, La. Later because of changed conditions in the lumber industry the projects were discontinued.

Since he has been associated with the Howard Smith Paper Mills Ltd., he has been the inventor of several commercially important patented processes. His greatest contributions to the industry have been in the field of the manufacture of chemical pulps, by applying research and sound engineering principles toward the better utilization of wood and other materials.

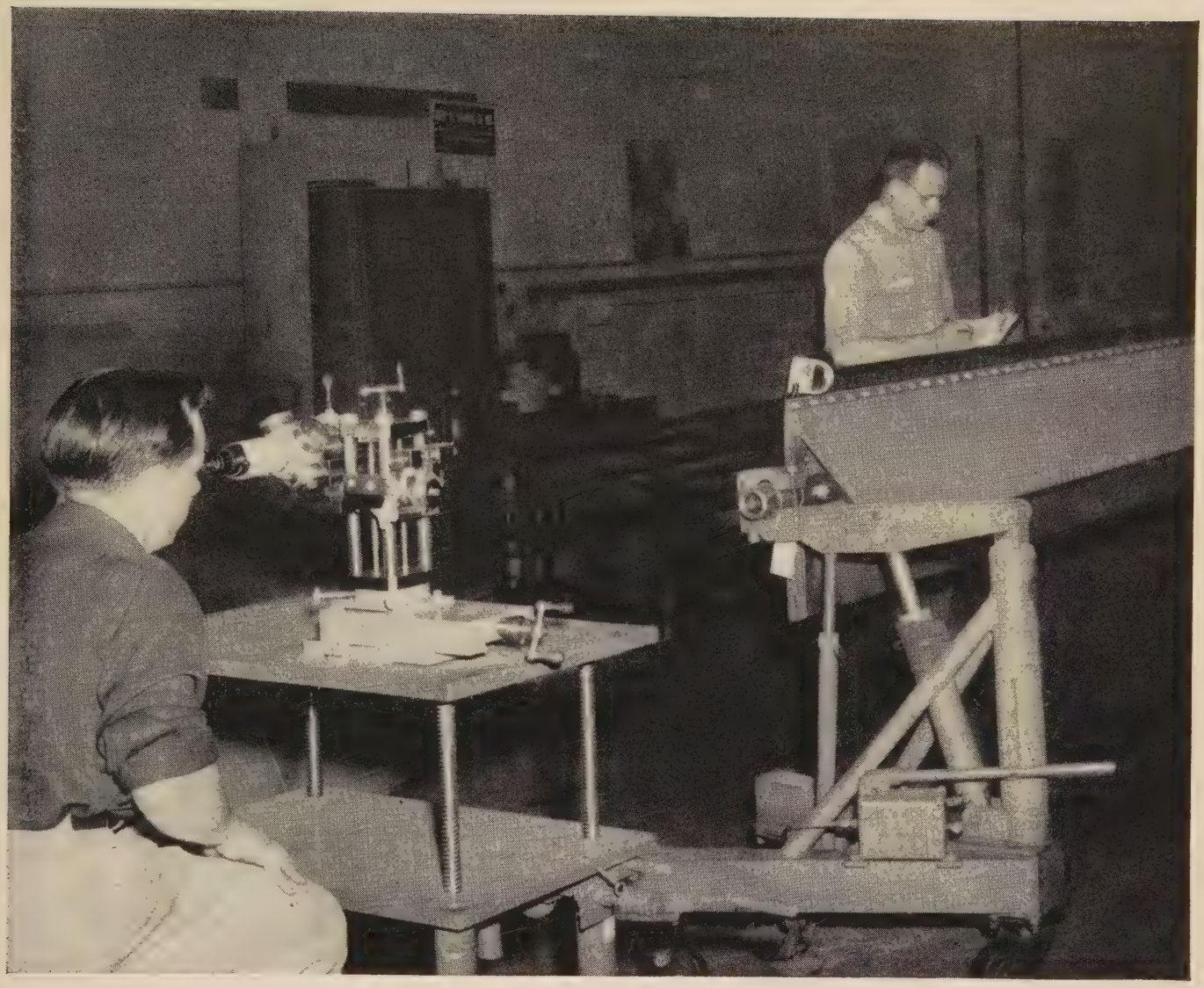
Mr. Tomlinson designed and was responsible for the early operation of a soda mill in Cornwall, Ont. which in 1927, operated with a combination of such now well-established process stages as continuous vacuum brown stock washing, multiple-stage evaporation, stationary recovery furnaces and continuous causticization. He also pioneered in the continuous multiple-stage bleaching of pulp, such processing being of importance in the case of difficultly bleachable kraft pulps.

His best-known development in the alkaline processes is the B & W Tomlinson recovery furnace, through which a large percentage of the world's kraft liquor is now being processed.

In the sulphite pulping field Mr. Tomlinson experimented with such developments as indirect cooking with acid circulation, acid-preheating, and blow-heat and sulphur recovery.

In the field of lignin research, together with a number of associates, he developed plastic materials and developed a plant to manufacture vanillin.

Realizing the difficulties inherent in the evaporation and combustion of normal calcium-base sulphite spent liquor, he experimented with other bases and found that magnesium-base spent liquor could be readily neutralized with recovered magnesium oxide, evaporated with a minimum of corrosion and without scale, and the resultant liquor incinerated to yield recoverable heat, sulphur dioxide, and a pure, chemically reactive magnesium oxide. This latter by suspension in water, can then be continuously used for absorbing the regenerated sulphur dioxide thus obtaining fresh cooking acid and forming a cyclic process. In cooperation with the Babcock & Wilcox Co., a semicommercial scale pilot plant using the liquor from one 10-ton digester was built in Cornwall in 1936–1937. Entry of Canada into the war in 1939 delayed plans for full-scale commercial development. Arrangements were made for pooling of scientific information with the Weyerhaeuser Timber



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LODDING ENGINEERING CORPORATION, makers of quality blades, can supply your needs for all types of "K" Monel doctors. Write Lodding — Dept. K; Worcester, Mass. — for more information. And write us for help in picking the right metal for any corrosive job in your mill!

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Co., who were independently carrying on parallel research, and eventually resulted in the establishment of a full-scale plant at Longview.

Raymond S. Hatch (1952)

The twentieth medal to be awarded by the Technical Association of the Pulp and Paper Industry to an individual who has made outstanding contributions to the technical advancement of the pulp and paper industry went to Raymond S. Hatch, now vice-president of the Hudson Pulp & Paper Co., Palatka, Fla.

Mr. Hatch graduated from Syracuse University in 1904. His professional experience included employment by the Massachusetts Institute of Technology, the Ozone-Vanillin Co., Heller & Merz Co., Crocker-McElwain Co., Pulp Bleaching Corp., Hammersley Mfg. Co., Peerless Paper Co., and finally up until his time of retirement he was director of research for the Pulp Department of the Weyerhaeuser Timber Co., Longview, Wash. Upon retirement from Weyerhaeuser he established a consultation practice at Monterey, Calif. This work led him recently to join the Hudson Pulp & Paper Co. to organize a research department at Palatak, Fla.

Mr. Hatch was a charter member of the Technical Association of the Pulp and Paper Industry and was president of the Association in 1919 and 1920.

He has contributed many scientific papers to the literature of pulping woods and conserving wood through utilization of the nonfibrous part of the wood. He has patents on plastics and Douglas-fir bark separation.

Among his several technical contributions are the following: he developed the twin-strength curve which is now universally used in denoting the strength properties of pulps. He conducted a successful exploration into the use of various bases and conditions for cooking sulphite pulp that led ultimately to the establishment of the magnesium-base sulphite pulping and recovery system now in use by Weyerhaeuser at Longview, Wash. He evaluated the various species of western woods for use in the kraft and sulphite processes; and his research work on pulp bleaching methods and improvements in commercial scale practice is well known. He was editor of the monograph on pulp bleaching.

Roger C. Griffin (1953)

The twenty-first medal to be awarded by the Technical Association of the Pulp and Paper Industry to an individual who has made outstanding contributions to the technical advancement of the pulp and paper industry went to Roger C. Griffin, of Needham, Mass.

Mr. Griffin was born in Montclair, N. J., on Sept. 11, 1883, and graduated from Harvard University (magna cum laude) in 1904. He received his A.M. degree in 1905 and S.M. in chemistry in 1906. During time in the Harvard Graduate School he held the Austin Teaching Fellowship and the Mallinckrodt Scholarship.

He joined the staff of Arthur D. Little, Inc. in Boston in January, 1909. R. C. Griffin was a director of this corporation for 20 years, treasurer for 9 years, and vice-president for 3 years, retiring on Jan. 1, 1949, after 40 years of service. He was a director of Skinner & Sherman, Inc., from 1939 to 1949.

In association work, Mr. Griffin was a member of the American Chemical Society since 1909. He organized Committee D-6 on Paper for the American Society for Testing Materials and served 4 years as its first chairman (1937–40). He was a member of the ASTM Executive Committee from 1940 to 1942.

He was a member of TAPPI from 1915 to 1918 and since 1926. From 1929 to 1932 he was chairman of the Nonfibrous Materials Testing Committee and General Chairman of the Testing Division from 1933 to 1936. He has been chairman of the Standards Committee since its inception in 1933. From 1936 to 1941 he was a member of the TAPPI Executive Committee and was chairman of the New England Section in 1936.

His famous book "Technical Methods of Analysis" was published in 1921, the second edition in 1927. This book was probably the first of its kind to include specifications and other data on various materials as a guide in the interpretation of analytical and test results. It contains a chapter of over 100 pages on the analysis of wood, paper, and papermaking chemicals. In addition, he published some 20 articles having to do with analysis and testing in various technical journals, and the annual reports of the TAPPI Standards Committee since 1936.

One of the principal accomplishments of the Technical Association has been the development of its Standard Testing Methods, Specifications and Recommended Practices. Although a large number of Association members have assisted in the preparation of the Standards, their final excellent form has been due, for the most part, to the careful editing of Mr. Griffin.

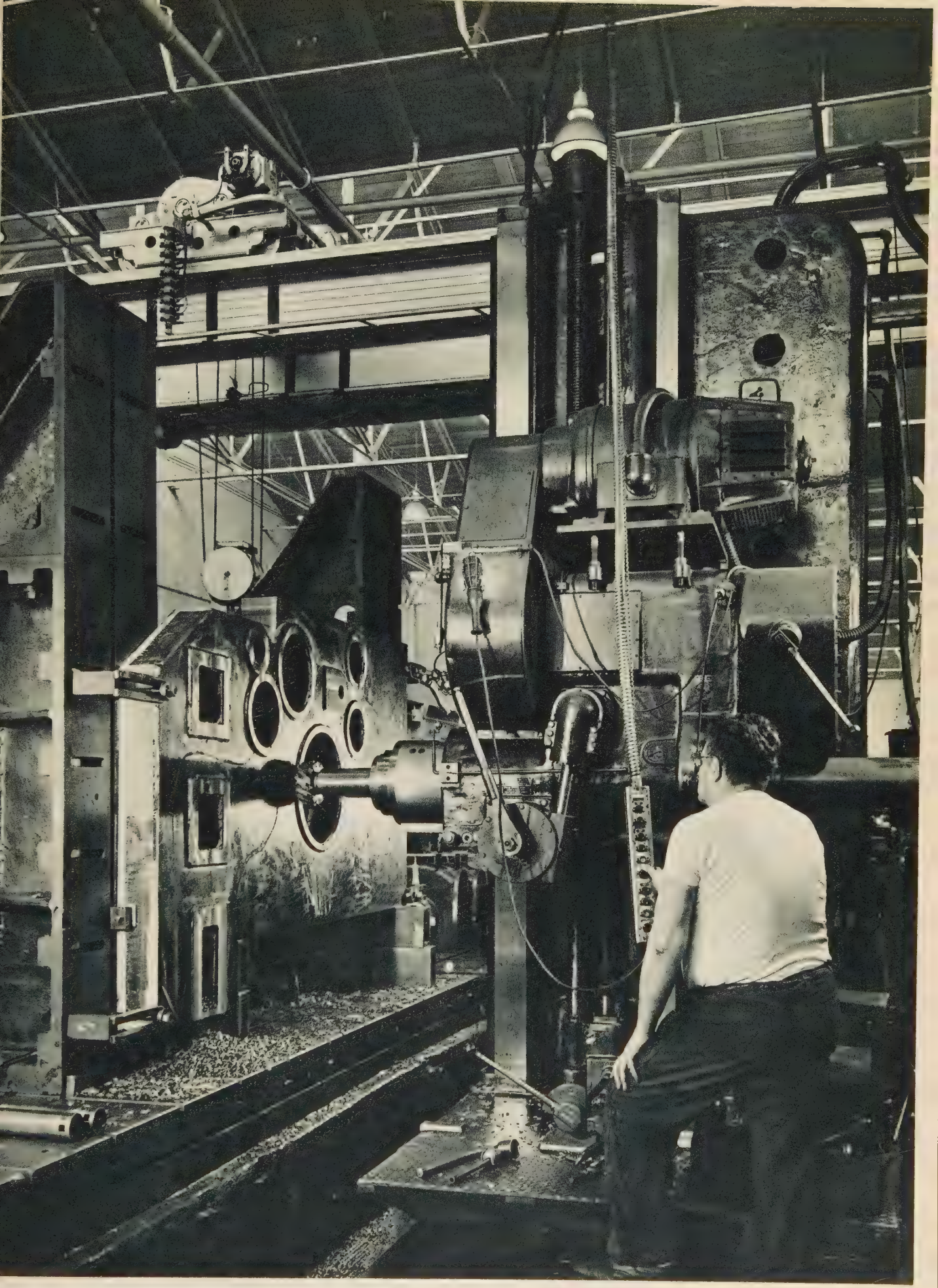
Gunnar W. E. Nicholson (1954)

Gunnar W. E. Nicholson, executive vice-president of the Union Bag & Paper Corp., was chosen by the TAPPI Executive Committee to receive the twenty-second medal.

Mr. Nicholson was born in Sweden on July 11, 1893, and graduated as a chemical engineer from Chalmers Institute of Technology in 1916. From 1916 to 1927 he held various jobs in a number of paper mills in Sweden, Canada, and the United States. From 1927 to 1931 he was general superintendent of the Bogalusa Paper Co., Bogalusa, La. Between 1931 and 1941 he was superintendent and manager of the Mobile, Panama City and Georgetown mills of the Southern Kraft Div., International Paper Co. From 1941 to 1945 he was resident manager of the Savannah, Ga., mill of the Union Bag & Paper Corp. In 1945 he became vice-president of the company.

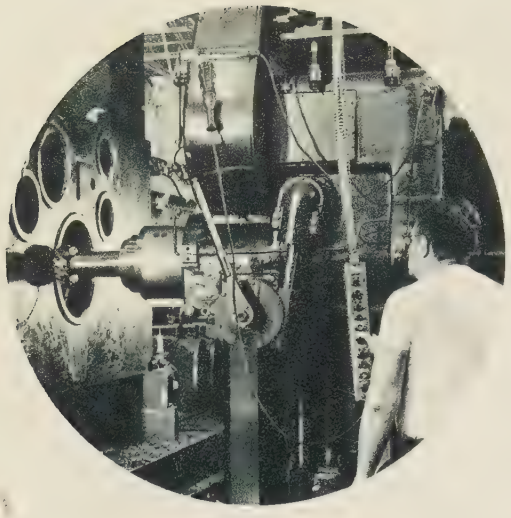
Mr. Nicholson was president of TAPPI in 1946.

In 1946 he was awarded the golden medal by the Swedish Association of Pulp and Paper Engineers for his outstanding contributions to international pulp and paper technology. At the same time he was voted an honorary membership in the Association, an honor bestowed on only three other persons. In 1949 he was decorated with the Royal Order of Vasa, rank of Knight, First Class, by his Majesty Gustaf, King of Sweden, for his contribution to industry cooperation between the United States and Sweden.



TORKEL KORLING

ILLING A BIG ONE . . . *South Shop at Beloit Iron Works.* | *For further details, please turn the page.*



MILLING A BIG ONE

Pictured on the preceding page is one of the large milling machines located in the south machine shop at Beloit Iron Works, Beloit, Wisconsin. A spindle travel of eight feet vertically and 22 feet horizontally permits machining of large bulky castings and fabrications like the one pictured: the pond side for an air-cushioned inlet. Skilled machinists working with modern machine tools make each Beloit product a precision product built for years of dependable service.

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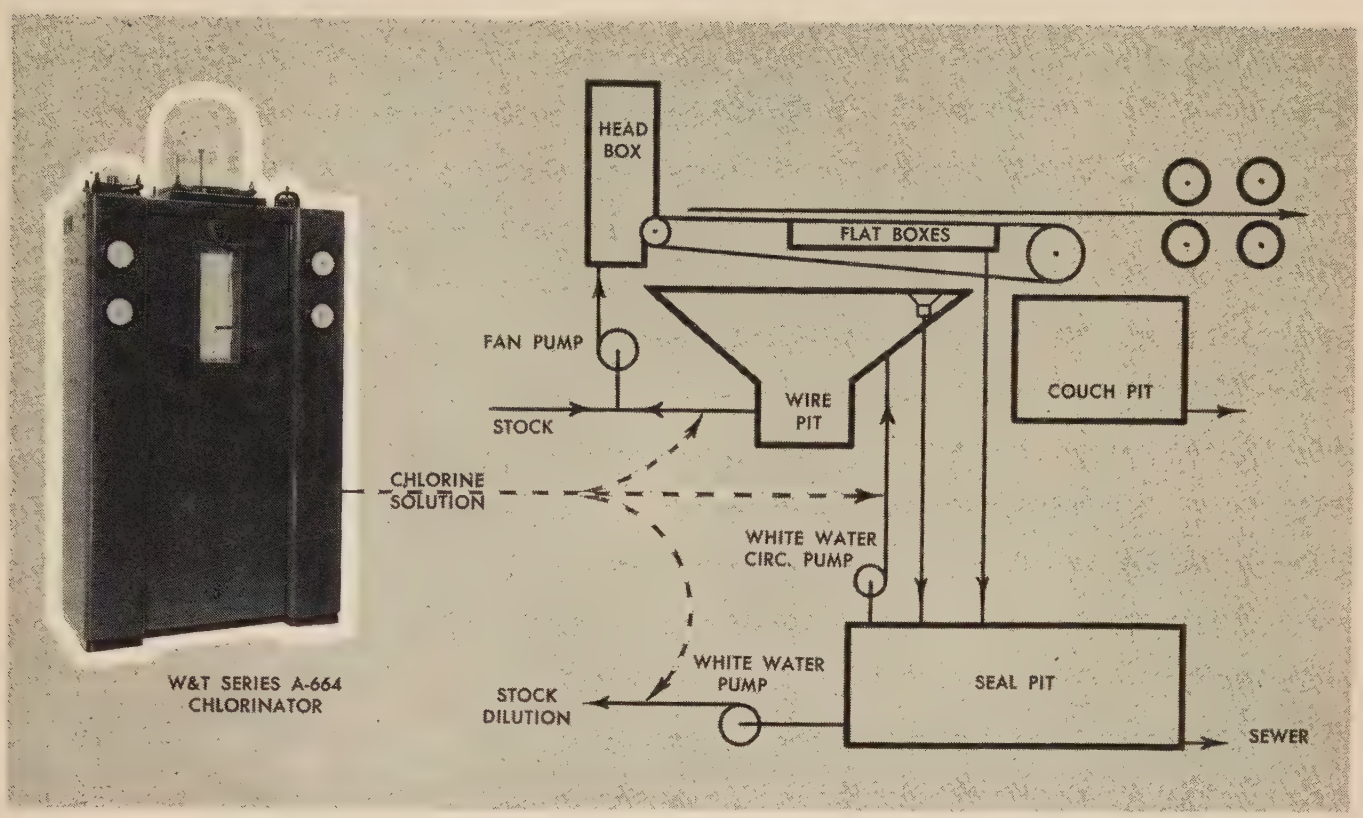

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The Wallace and Tiernan Series A-664 Chlorinator shown above is one of a complete line of W&T Chlorination equipment, designed to give dependable chlorination at all feed ranges.

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1-53

Vance P. Edwardes (1955)

The twenty-third medal to be awarded by the Technical Association of the Pulp and Paper Industry to an individual who has made outstanding contributions to the technical advancement of the pulp and poper industry was awarded to Vance P. Edwardes, of Corinth, N. Y.

Mr. Edwardes was born in San Francisco, Calif., and was graduated in mining engineering from the University of California in 1911.

After four years as a chemist and chemical engineer with the Crown Willamette Paper Co. in Portland, Ore., in 1917 he joined the staff of the Forest Products Laboratory, Madison, Wis., where he conducted experimental work in pulping until 1921, when he joined the Interlake Pulp and Paper Co., in Appleton, Wis. In 1924 he returned to Madison and in 1927 he conducted the first course in sulphite pulping, which was followed by a second course, also conducted by Mr. Edwardes, in 1929. For 20 years from 1929 to retirement he served the International Paper Co. as sulphite consultant, responsible for technical operations of pulping and bleaching in eleven mills of the company in northern United States and Canada. More recently as a consultant, he has undertaken special missions to Austria for ECA and Italy for FOA.

Mr. Edwardes has published some 35 papers on all aspects of sulphite pulping. He has been a member of TAPPI since 1917, was chairman of the Sulphite Committee, member of the Executive Committee, and in 1944 and 1945 was president of the Association. While he was president the Association established the Maine-New Hampshire Section and held the first Alkaline Pulping Conference.

TAPPI FINANCED RESEARCH

The Research Appropriations Committee (formerly the Committee on Educational Cooperation) was initially appointed in 1935 by the Executive Committee to administer funds for the purpose of assisting TAPPI committees in financing their projects. It was realized that some committee projects could not be undertaken unless financial aid was forthcoming. The work of other committees could be accelerated and the results be obtained sooner, if some financing were available. Thus, by the proper use of TAPPI funds, not only would the work of the committees be promoted and furthered, but also, those objects of the Association relating to investigation and research, and the providing of technical facts, data, and standards fundamental to pulp and paper manufacture and use would be carried out.

The personnel of the committee were the vice president, the chairmen of the various divisions, and a chairman until 1951 when the organization was revised by the Executive Committee. The committee now comprises 12 members, including the president and vice president serving *ex officio*, and appointees who serve a 3-year term on a rotating basis.

The Executive Committee originally adopted the policy that a project for which financial aid is requested must be an authorized committee activity, initiated by the group and over which continuing review is maintained, and this policy has been maintained.

Since 1935, 74 requests for appropriations have been received and 67 grants have been made. These grants, through 1954, totaled $150,732.60. To this can be added $32,348.65 which was granted January to June, 1955.

TAPPI Research Grants from 1935 to 1955

Research project No.	*Appropriation, dollars*	*Year*	*Project*	*Committee*
1	150	1935	Study of mechanical pulp refiners by fiber classification	Mechanical Pulping
2	1,000	1935	A study of the existence and nature of fiber membranes	Fundamental Research
9	1,1000	1937R[a]		
3	...	...	(Cancelled by sponsoring committee)	Container
4	600	1936	An investigation of holocellulose	Fibrous Materials Testing
8	600	1937R	.....	Fibrous Materials Testing
10	600	1938R	.....	Fundamental Research
12	1,000	1939R	.....	Fundamental Research
17	1,200	1940R	.....	Fundamental Research
5	220	1936	Bibliography: Microscopy of Paper	Microscopical
6	600	1936	Measurement of the gelatinization of cellulose and wood	Fundamental Research
7	75	1937	Stability of calcium hypochlorite bleach liquor	Nonfibrous Materials
11	1,000	1938	An investigation of the relation of lignin content to the strength of paper and pressed boards	Fundamental Research
14	1,000	1939R		
18	1,000	1940R		
13	540	1939	Survey of materials of construction used in kraft mills, and in the bleach plant, and an investigation of piping in the pulp and paper industry	Materials of Construction
15	750	1939	Use of hydroxyamines for cellulose analysis	Fibrous Materials Testing
16	250	1939	Preparation of a negative for dirt estimation chart for methods T 213 m-39 and T 437 m-39	Pulp Testing and Paper Testing
19	650	1940	A study of different types of oxidized cellulose and their identification	Fundamental Research
20	800	1941	Investigation of pump and valve packing materials, and materials for process piping and tubing used in kraft pulp mills	Materials of Construction
21	1,700	1946	Variation of drying rate of individual driers through the drier section	Drying and Ventilating
22	350	1947	Preparation of an annotated bibliography on alkaline pulping for 1946	Alkaline Pulping
23	...	...	(Request for grant not approved)	
24	2,000	1949	Structure of lignin	Fundamental Research
25	500	1950	Frietion of stock in pipes	Hydraulics
27	2,500	1951R		

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UFORMITE 711 is highly efficient over a wide range of resin-to-pulp ratios. As little as 0.5 percent gives good wet-strength; 3.0 percent gives maximum values. It is easy to mix: no acid pre-treatment, aging or special equipment is required. The pH can be controlled with acid, alum, or blends of each.

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Research project No.	*Appropriation, dollars*	*Year*	*Project*	*Committee*
37	6,275	1952R		
49	5,000	1952R		
26	1,200	1951	Cellulose viscosity methods	Chemical Methods
45	1,800	1952R		
28	2,000	1951	Thermodynamic properties of ammonium and magnesium bisulphite solutions	Acid Pulping
47	2,000	1952R		
29	1,000	1951	Construction and testing of two freeness testers of new design	Structural Fibrous Materials
41	512	1952R		
30	2,000	1951	A study of the sugars obtained by hydrolyzing the skin-like substance obtained from the treatment of pulp fibers with cuprammonium hydroxide	Fundamental Research
31	3,500	1951	Dye adsorption technique for determining the external specific surface of fibers	Fundamental Research
32	1,000	1951	Determination of the effect of rate of loading in the "Flexural Resistance and Deflection of Fiberboard" test	Structural Fibrous Materials
33	2,500	1951	Determination of a method of test for the racking strength of insulating board sheathing	Structural Fibrous Materials
34	...	1951	(Request for grant not approved)	
35	3,946	1951	Construction and testing of a test board forming machine for structural fibrous materials	Structural Fibrous Materials
36	4,000	1951	Analysis of data on corrosion of digesters in kraft and soda mills	Chemical Engineering
38	...	1952	(Request for grant not approved)	
39	...	1952	Statistical conference (referred to Executive Committee)	Statistics
40	1,500	1952	Development of standard methods for analysis of mill waste. Suspended solids determination of Buchner vs. Gooch methods	Water
42	1,364	1952	Purchase, alteration, and evaluation of a Baumgartner sphere for measurement of the light reflection from insulating board finishes and coatings	Structural Fibrous Materials
43	2,500	1952	Species identification of wood and wood fibers	Fibrous Raw Materials Testing
44	4,500	1952	Study of North American barks of interest to the pulp industry	Fundamental Research
46	2,500	1952	Correlation between lignin content and high kraft yield pulps and the chlorine number test	Alkaline Pulping
48	500	1952	Method for determination of the chain length distribution of cellulose	Chemical Methods
50	$6,000	1953	Study of Corrosion in Alkaline Digesters by Analysis of Wall Thickness Measurements	Chemical Engineering (Digester Corrosion Subcommittee)
51	$5,000–$7,000	1953	Permeability of Plastics Treated Paper to Gases and Liquids	Plastics
52	($2,500)	1953	Study of Skinlike Substance from Residues of Pulp Fiber Treatment (continuation of no. 30)	Fundamental Research
53	$2,800	1953	Dye Absorption Method of Determining the External Specific Surface of Pulp and Correlation with Other Fiber Properties (continuation of no. 31)	Fundamental Research
54	$1,500	1953	Structure of Lignin (continuation of no. 24)	Fundamental Research
55	$3,000	1953	Sulphonation of Lignin	Fundamental Research
56	$5,000	1953	A Study of Certain Factors Involved in Semichemical Pulping	Fundamental Research
57	$900	1953	Method for the Determination of the Chain Length of Cellulose (continuation of no. 48)	Chemical Methods
58	$900	1953	Development of a Method for the Measurement of the Ratio of Crystalline to Amorphous Material in Cellulose	Chemical Methods
59	$2,050	1953	Dirt in Wood Chips (revision of Tentative Standard T 14 m-47)	Fibrous Materials Testing
60	$2,000	1953	A Study of the Reaction Between Water and Cellulose in the Temperature Range 100°C. and 225°C.	Fundamental Research
61	($5,500)	1953	Losses of Straw Stored in Ricks	Fibrous Agricultural Residues
62	($4,800)	1953	Study of North American Barks (renewal of no. 44)	Fundamental Research
63	$2,000	1953	F.P.L. Small-Scale Tunnel Fire Test	Structural Fibrous Materials
64	($11,000)	1953	Friction of Paper Stock in Pipes (renewal of no. 49)	Hydraulics
65	($1,500)	1953	Nature of Uronic Acids	Fundamental Research
66	$2,500	1954	Vapor Equilibrium Data for the Systems Magnesium Oxide-Sulphur Dioxide–Water, and Sodium Oxide–Sulphur Dioxide–Water	Acid Pulping
67	$3,000	1954	Statistical Analysis of Digester Wall Thickness Measurements	Chemical Engineering
68	$4,500	1954	Study of Isolation of Dimers from Lignin	Fundamental Research
69	$6,500	1954	Printer-Slotter-Creaser Contour Study	Corrugated Containers
70	$2,400	1954	Disperse Cellulose Viscosity (Continued)	Chemical Methods
71	$400	1954	Statistical Analysis of Digester Wall Measurements (Continued). Supplementing Grant 67	Chemical Engineering
72	$6,000	1954	Study of Flow Properties of Paper Coating Mixes	Coating
73	$7,400	1954	Permeability of Plastic Treated Paper to Gases and Liquids (Continued)	Plastics
74	$700	1954	Determination of the Accessibility of Cellulose (Continued)	Chemical Methods

[a] The letter "R," following the year, indicates renewal of grant.

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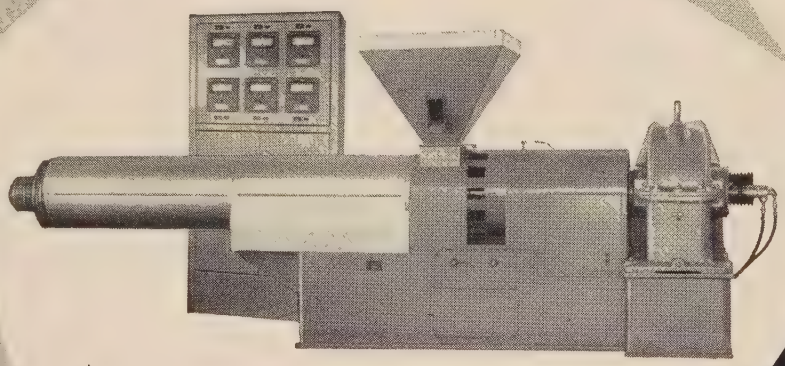

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The preceding table is a summary of the grants which have been made by the Technical Association of the Pulp and Paper Industry. It is to be mentioned that the final reports were published in the *Paper Trade Journal* and/or *Technical Association Paper* prior to the publication of the Association's journal. Since 1949, the reports, as released, have appeared in *Tappi*.

The personnel of the Research Appropriations Committee for 1955 comprises the following:

K. O. Elderkin (*ex-officio*)
W. D. Harrison (*ex-officio*)
K. P. Geohegan (1955)
A. L. Sherwood (1955)
W. H. Swanson (1955)
J. d'A. Clark (1956)
C.. C. Heritage (1956)
W. W. Moyer (1956)
P. F. Neumann (1957)
G. W. E. Nicholson (1957)
G. H. Pringle (1957)
J. L. Parsons, *Chairman*

TECHNICAL ASSOCIATION PAPERS

The principal publication of the Association from 1918 to 1949 was *Technical Association Papers*. As in other organizations the Technical Association found that printing and publishing are expensive items but are vital to the service to members who have grouped themselves together to exchange and obtain needed information to aid them in their responsibilities to their employers.

When the Association was started it received the wholehearted support of the weekly magazine *Paper*, of which Thomas J. Keenan, the first secretary-treasurer was editor. In this way the Association was kept free from publishing expenses to an important degree.

In 1918 the Association began to publish its meeting papers and proceedings. This was a 68-page, paper-bound volume called *Technical Association Papers*. Since that time this publication was issued annually until in 1948 it reached 822 pages. Starting in 1935 it was substantially bound in cloth.

In addition to publishing its articles in *Technical Association Papers* the Association continued to contribute articles and items to the various trade papers. *Paper* continued to be the official organ until 1921 when *Paper* was purchased by the *Paper Trade Journal* and continued the policy of *Paper* in publishing the Association's contribution to the pulp and papermaking literature.

Since the Association was started it has published literally thousands of articles of real value to practical papermakers, engineers, chemists and executives of pulp and paper mills. It would require a great amount of space to list even part of these publications.

The results produced by *Technical Association Papers* was of immeasurable value to the industry. It cleared the way for vocational education of the highest type, focused attention on all the processes and equipment developments, and demonstrated the value of the technically trained man to the industry.

Tappi

Over the years previous to 1949, there had been some consideration as to the feasibility of the Association publishing its own journal. In spite of the excellent cooperation of the *Paper Trade Journal* it was felt that an Association magazine would be of more service to the members inasmuch as more space could be devoted to its activities. After considerable discussion in the Executive Committee, it was decided that starting with January, 1949, the Technical Association would publish a monthly magazine to be called *Tappi*. R. G. Macdonald, secretary of the Association, was named editor and R. T. Bingham of the staff, assistant editor. The policies would be overseen by the Publications Management Committee who were members of the Executive Committee, appointed by the Association officers. To assist the editors, provision was made to set up an Editorial Board that would be composed of experts in several fields to which manuscripts could be submitted for a decision as to the acceptance of technical papers. C. J. West of The Institute of Paper Chemistry, was the first chairman.

Currently, the following individuals constitute the membership of *Tappi*'s Editorial Board:

K. W. Britt, Scott Paper Co., Chester, Pa., is an expert on tissue and wet-strength papers.
B. L. Browning, Institute of Paper Chemistry, Appleton, Wis., is an expert on analytical methods of testing.
L. K. Burnett, Manager of Production Control, Ohio Boxboard Co., Rittman, Ohio, is an expert on corrugated board.
R. L. Davis, Manager of Scott Paper Co., Detroit, Mich., is an expert in high grade paper manufacture.
G. A. Day, Brown Co., Berlin, N. H., is an expert on specialty wood pulp manufacture.
R. F. DeLong, Marathon Corp., Menasha, Wis., is an expert on microbiology.
F. C. Goodwill, Manager, St. Regis Paper Co., Bucksport, Me., is an expert on deinking and coating.
W. M. Hearon, Crown Zellerbach Corp., Camas, Wash., is a specialist in fundamental research.
H. G. Ingraham, Engineer, Chas. T. Main, Inc., Boston, Mass., is an expert on machinery and mill construction.
E. M. Jenkins, Section Chief, Johns-Manville Research Center, Manville, N. J., is an expert on structural fibrous materials such as wall board and insulating board.
Gerald Larocque, News Syndicate, New York, N. Y., is an expert in the graphic arts and printing.
E. C. Lathrop, Consultant, Peoria, Ill., is an authority on straw pulping and bagasse.
R. T. Nazzaro, Research Director, Westfield River Paper Co., Russell, Mass., is an expert on plastic coating and glassine.
C. C. Porter, Assistant to the Manager, Southland Paper Mills, Lufkin, Texas is an expert on water quality and utilization.
G. T. Renegar, Superintendent, Container Corp. of America, Manayunk, Pa., is an expert on paperboard and container manufacture.
R. H. Savage, Vice-President, Mead Corp., Chillicothe, Ohio, is an expert on printing paper manufacture.
C. J. Sibler, Chief Engineer, West Virginia Pulp & Paper Co., New York, N. Y., is a specialist on general engineering problems.
F. A. Simmonds, Forest Products Laboratory, Madison, Wis., is a specialist in dissolving pulps.
K. A. Taylor, International Paper Co., Glens Falls, N. Y., is experienced in the manufacturing of all paper grades.
C. A. Young, Manager of Engineering, Riegel Paper Corp., Milford, N. J., is an expert in paper drying and mill engineering.

Nearly every manufacturing interest relative to pulp and paper is covered by the Editorial Board.

As the form of the magazine developed, it appeared that it should be divided into two sections: A technical section and a general section. In the former papers presented at the Association's meetings and other manuscripts approved by the Editorial Board, according to the Regulations Governing Manuscripts section in the TAPPI Year Book, were to be published. These regulations can be briefly summarized.

1. The paper should present *original* work of interest to the pulp and paper industry.

2. The text and citations should be comprehensive and should include reference to previous work in the field covered.

3. The author or authors should present their data in a form that can be clearly understood.

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4. The data given should be in terms of the TAPPI Standards.

The general section became devoted to the publication of Association affairs under such typical headings as: Association News and Events, Personal Mention—Items about New and Old Tappimen, Divisions and Committees, Local Section Activities, Letters to the Editors, Recent Books, Employment Service, TAPPI Standards, etc. Also included are patent listings, bibliographies, and certain papers which, while not meeting the stringent requirements of the Editorial Board, do contain valuable material of current interest.

An examination of the back issues of *Tappi* will reveal the success of this venture of the Association.

The first issue, January, 1949, had 116 pages while January, 1955, had 236 pages. The ratio of text to advertising has held at about 2 to 1. Over these years a very large number of high quality technical papers have been published covering every phase of the industry and the general section has proved to be invaluable for the dissemination of information covering the Association's activities as well as carrying the accounts of the proceedings of the local sections.

In 1951, in a competition conducted by *Industrial Marketing, Tappi* was given the first award for editorial achievement-class, institutional and professional services. In 1952 the same organization awarded *Tappi* a certificate of merit.

PULP AND PAPER TEXTBOOKS

In 1918, when the project was undertaken, no books were available in English which brought together the principles and modern practice of pulp and papermaking. Books which treated of the several processes employed in the industry were too technical, too general, out of date, or so limited to European operations as to be unsuitable for use in North America. Moreover, a textbook was needed for the man who had to study at home because he could not attend classes. No classes were available in many localities.

After study of the situation and discussion in meetings, the Committee on Education of the Technical Section of the Canadian Pulp and Paper Association and the Committee on Vocational Education of TAPPI met in Buffalo, N. Y., Sept. 16, 1918, and set up a Joint Executive Committee (since rechristened the Joint Textbook Committee) instructed to proceed with plans for the preparation of texts, publication and distribution of the books. At this meeting, the representatives of the Canadian Pulp and Paper Association were George Carruthers, A. P. Costigane, T. L. Crossley, Don Daverin, C. Nelson Gain, and J. N. Stephenson. Appearing for TAPPI were Hugh P. Baker, Henry J. Guild, R. S. Kellogg, Otto Kress, W. S. Lucey, G. E. Williamson, and C. P. Winslow. The resulting Joint Committee was composed of George Carruthers, chairman, R. S. Kellogg, secretary, T. L. Crossley, G. E. Williamson, and C. P. Winslow. At the same time, J. N. Stephenson was appointed editor and has acted in that capacity to date.

Including the editor, this group has always consisted of six men, three from the United States and three from Canada—an exact international balance—whose actions have always been unanimous. In the course of events George Carruthers was succeeded by Harry Spencer and Tom Crossley by Douglas Jones in Canada. On the other side, Cap Winslow was followed by Ray Hatch and George Williamson by Ronald G. Macdonald. The chairmen in succession have been Carruthers, Williamson, and Spencer. Secretary Kellogg and Editor Stephenson are survivors of the original setup.

There were five volumes in the first edition, three revised volumes each in the second and third and four volumes in the fourth. A French translation of the second edition, under direction of the editor, was published by the Garden City Press in Canada, thus making a total of 20 separate volumes.

Total sales of the first three editions and of three volumes of the fourth edition are reported as follows by the publishers.

First Three Editions	*1954 Sales or Returns*	*Grand Total*
Vol. I	11 net returns	6,341
Vol. II	....	5,511
Vol. III	....	15,339
Vol. IV	....	12,675
Vol. V	30 returns	11,499
	41 returns	51,365
Fourth Edition		
Vol. I	1216[a]	8,011
Vol. II	1659[a]	6,072
Vol. III	1998[a]	5,053
Total	4873	19,136

[a] Segregation into domestic and foreign sales not given. Such information is not yet available for the last half of 1954.

During the nearly 37 years of its activities, the committee has always been financially solvent. The early operations were based upon a round sum of $57,000 contributed by the North American paper manufacturers. It has spent some $115,000 and still had a neat balance of $4000 on Jan 1, 1955, and no obligations. This seeming miracle is the result of over $61,000 in royalties paid by the publishers and co-workers, the McGraw-Hill Book Co. Nearly $39,000 was realized on the sales of over 51,000 volumes.

The feature of these textbooks is the fact that the various sections have been prepared by experts in their particular field. None of the authors have received remuneration for their activities, their sole reward being the appreciation of the associations involved and the thanks of those who have been assisted by their study of the textbooks.

TAPPI SPECIAL REPORTS ON MANUFACTURING PROBLEMS

The Technical Association has always been essentially a clearing house on subjects relating to the operation, engineering and technology of pulp and paper manufacture.

In addition to the subjects discussed at meetings and the literature published every effort has been made to encourage members to present specific problems. Because of its broad membership the Association has resources of tremendous factual information.

To mobilize these resources the Association issued a bulletin in September 1921 in which it announced its Service to Members Plan. The first step in its effort to give improved service was the distribution of a questionnaire in which members were asked to indicate on a check sheet, subjects on which they had special knowledge. Every department of a mill was indicated, together with the equipment and unit operations used.

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In this way mailing lists were built up to enable the Association to present questions to those members who were best qualified to give information.

The first three reports were designated as x, y, and z and were compiled by F. C. Clark and G. N. Collins who were the first members of the Service to Members Committee. These reports dealt with x. Relative Width of Felts and Press Rolls, y. Causes of High Sulphur Consumption in Sulphite Pulp Manufacture, and z. Substitute for Poplar for Soda Pulp. These were issued on June 27, July 10, and July 13, 1923. On February 29, 1924 Special report no. 1 was issued. This was entitled Lime Formation in Sulphite Blowpits.

Beginning with Report No. 7 the compilation of responses was made by W. G. MacNaughton, secretary-treasurer, and since that time all reports have been prepared by the Association's office staff.

From the beginning the identity of the respondents has been kept confidential and carefully in the locked files of the Association.

The reports, when ready, have been issued to those members who contributed information and to the corporate members of the Association. File copies have been kept available for use in the Associations offices and have been referred to by a large number of individuals. Many inquiries have been received which have been answered to by supplying data from issued reports. On Sept. 22, 1955, Special Report No. 408 was issued. The TAPPI Year Book contains a list of the reports that have been issued.

In addition to the information issued as Special Reports the Association has responded to hundreds of daily inquiries on many problems, most of which have been of a technical nature. The Special Reports have been based on inquiries that required data from a number of companies or individuals.

TAPPI STANDARDS

The Standards Committee was formed in 1933 for the purpose of establishing regulations governing TAPPI standards, editing and passing upon standards, and coordinating standardization activities within the Association and with other organizations.

Up to 1955 the Association has adopted 213 standards, largely testing methods.

In the early days of the Association its standards were published in the *Paper Trade Journal* in whatever form they were submitted by the various committees. This naturally resulted in considerable nonuniformity. The Standards Committee established regulations clearly defining a uniform procedure for preparing and presenting TAPPI Standards and suggested methods and for identifying them for subsequent publication in loose-leaf form for the convenience of members and others interested.

The standards are divided into four classifications: standard recommended practices (13), standard specifications (5), standard testing methods (167), and suggested methods (28). The suggested method differs from the standard in that the originating committee recommends the method as being the best available at the time but does not consider it advisable to be adopted as a tentative standard. The regulations are fully covered in the TAPPI Year Book.

With the formation of *Tappi* all new and revised standards have been published in a special section and while not in the official loose-leaf form, they are printed from copy released by the Standards Committee. By this publication the information is disseminated as it is released and is an aid in securing such criticisms as may be thought to be advisable by the association membership at large.

With the formation of Committee D-6 on Paper and Paper Products by the American Society for Testing Materials the Standards Committee increasingly realized the importance of cooperation and coordination of the standardization work of the Technical Association with that of committee D-6, particularly in paper testing. The outcome of its efforts in this direction was the formation in 1937 of the ASTM-TAPPI Joint Paper Testing Committee.

The work of the Standards Committee has received its greatest support from its chairman, Roger C. Griffin, formerly with A. D. Little, Inc., now retired, who, through his devoted interest and his impartial criticism, has guided the standards to their high reputation.

It is the aim of the Standards Committee, where there is the need or an expressed desire in the industry for a particular standard testing method, recommended practice or specification, to further the preparation of such a standard through the appropriate TAPPI Committee. The chairman of the standards committee welcomes criticisms, suggestions, or inquiries regarding standards.

A list of TAPPI Standards is to be found in the TAPPI Year Book.

TAPPI ROUTINE CONTROL METHODS

With the continuing activity in the field of pulp, paper, and paperboard testing in all its phases, there grew the realization that while the TAPPI Standards were performing their avowed function, there was a need for a compilation of methods which had not reached a standard basis, even as a suggested method. These procedures would include those which had been found to be valuable in mill or product control but for which there was insufficient technical background to warrant further consideration.

Under the direction of J. d'A. Clark, then chairman of the Testing Division, an inquiry was sent to the industry asking mills and individuals to forward to the Association such methods that they had found useful. A large number were received and after careful editing by R. C. Griffin they were published as TAPPI Routine Control Methods. The first group, numbering 157, was issued in January, 1950, with additions of 66 in January, 1953, and 28 in July, 1954. Because of a certain degree of similarity to the Standards, they were printed on yellow stock and the editorial style was altered to prevent confusion.

At the time of their origin it was hoped that the Routine Control Methods would serve as a stepping stone for the advancement of those formed by experience to be qualified to TAPPI Standards. A committee was formed and placed under the Testing Division. To augment the division efforts, a plea was directed to the various local sections for them to assist the program.

The Routine Control Methods Committee was reorganized in 1955 and under the chairmanship of E. E.

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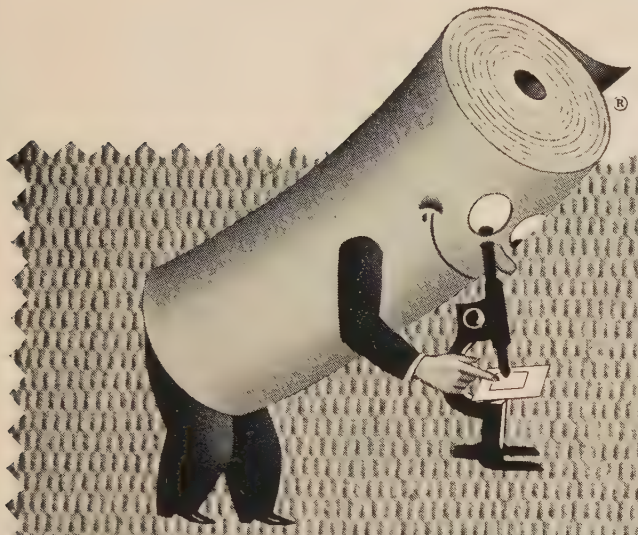

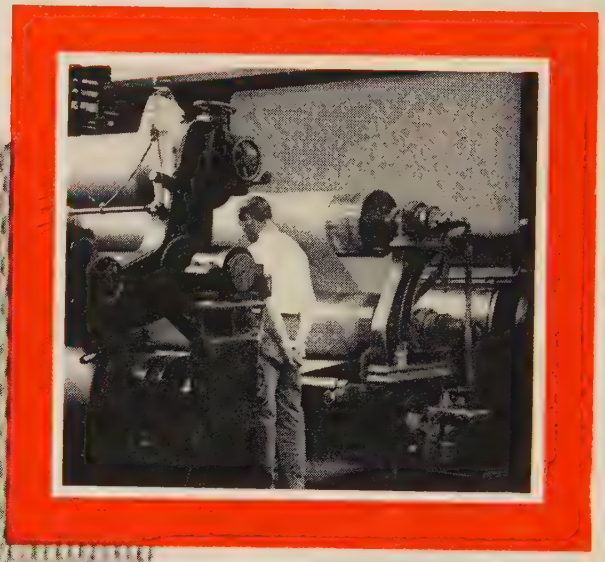

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TAPPI MONOGRAPHS

The textbooks on the manufacture of pulp and paper serve a real industrial need in outlining with considerable detail the processes commonly used. For obvious reasons these volumes must be limited as to the amount of detailed information to be included. Such information should, however, be made available and it is the intention of the Association to issue separate publications covering in as much detail as possible subjects of interest.

The first monograph was published in 1942, being prepared under the direction of the Water Committee, L. B. Miller, chairman. Its title was "Industrial Water for Pulp, Paper and Paperboard Manufacture" and it dealt with the use of water for process and boiler feed in the pulp and paper industry. This publication has been long out of print and the present Water Committee is engaged in preparing an up-to-date edition.

Monograph No. 2 "Saving Fourdrinier Wires" was prepared for the Association by J. E. Goodwillie of the Beloit Iron Works and was distributed in 1942 as an aid to the nation's conservation program.

Monographs No. 3 "Starch for Paper Coating" (1947), No. 5 "Resins for the Paper Converter" (1947), No. 7 "Pigments for Paper Coating" (1948), No. 8 "Machinery for Paper Coating" (1950), No. 9 "Protein and Synthetic Adhesives for Paper Coating" (1952), and No. 11 "Preparation of Paper Coating Colors" (1953), were all prepared under the direction of the Coating Committee and all but the last, under the chairmanship of the late Werner Kaufmann.

The Fundamental Research Committee sponsored two meetings, the first in Detroit in 1946 and the second in Appleton in 1947. The record of these two conferences were compiled into two monographs: No. 4 "Pulpwood, Stands, Procurement and Utilization" (1947) and No. 6 "Nature of the Chemical Components of Wood" (1948).

"Pulp Bleaching," Monograph No. 10 was an extensive undertaking of the Pulp Purification Committee and was published in 1953. R. S. Hatch served as editor, as well as being author of several chapters, and because of its size it was issued in a cloth binding.

Monograph No. 12, published in 1954, was "Inspection of Digesters." This was sponsored by the then Corrosion Subcommittee of the Chemical Engineering Committee. This subcommittee is now a separate committee. This work was the result of a group interested in the cause and prevention of corrosion in sulphate pulping digesters and served to bring the industry up to date on this pressing problem.

The Wet Strength Committee was responsible for the preparation of Monograph No. 13 "Wet Strength in Paper and Paperboard" which was issued in 1954.

The TAPPI Fundamental Research Committee sponsored TAPPI Research Grant No. 44 whereby Ying-Pe Chang did extensive research on 20 common North American pulpwood barks at the Forest Products Laboratory in Madison, Wis. The results of this investigation comprise the contents of Monograph No. 14 "Anatomy of Common North American Pulpwood Barks." This was published in 1954.

Monograph projects are being carried on by many of the TAPPI committees so that more can be expected in the future. The process of compilation of data and the preparation of the copy is a slow, exacting task which makes it impossible to set up a publication schedule. However, the members of TAPPI can expect to receive in the future additional material which will supplement and increase the technical literature of the pulp and paper industry.

TAPPI DATA SHEETS

To assist engineers, superintendents, and other technical men in their work the Association issued a looseleaf binder to all members in 1940. This binder contained compilations of specific information on the subjects mentioned in the list of data sheets.

The Association is indebted to the Engineering Committee of the Canadian Pulp and Paper Association for many of the sheets since that organization began issuing these sheets some time prior to the Technical Association. At the present time and in the future the two organizations will cooperate in gathering valuable data, not found in the readily available engineering handbooks. In time it is possible that this information will be reclassified and issued as a pulp and paper mill engineers handbook. Each Data Sheet is given a number and in many cases there are several sheets having the same number but with a special letter designation added. As more information is obtained on any subject already covered, sheets with new letter designations will be added.

The assembly of the Data Sheets is the responsibility of the Data Sheet Committee of which J. W. Hemphill of the Johns-Manville Sales Corp. is chairman. Since it is under the Engineering Division it has the active cooperation of the other committees of the division as well as the other committees of the Association. All contributed material is carefully reviewed by the committee. It is then published in a special department in *Tappi*, and, usually once a year, it is reprinted on a punched sheet for insertion in the looseleaf Data Sheet binder. To date 166 have been issued.

BIBLIOGRAPHY OF PAPER MAKING

The record of the "Bibliography of Paper Making" is the unique tribute to the one man who made it possible, the late C. J. West of The Institute of Paper Chemistry. It has been stated that the paper industry has the most complete bibliography of any industry, and up to the time of his death, Dr. West worked to make it so. The Association recognized his efforts by awarding him the TAPPI Medal in 1937.

Originally, the references were included in *Technical Association Papers* and later as the number increased they were issued in a paper-bound booklet. With the assistance of the Lockwood Trade Journal Co. the first compilation was published in cloth binding covering the years 1900–28. In 1935, the second was issued, 1928–35. Starting in 1936 the Association undertook the financial obligation of publishing on a yearly basis, the literature and patent references in a cloth bound book for distribution to its members. This has been continued with the exception of the years 1945 and 1950 when compilations were issued for 1936–45 and 1946–50.

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Upon the death of Dr. West in January, 1953, arrangements were made with The Institute of Paper Chemistry to continue the bibliographies for the Association.

There was one other bibliography issued by the Association. In 1937, "Microscopy of Paper," compiled by John B. Calkin was issued.

Also to be noted were "Papermaking Abstracts" of which two parts were issued before being discontinued. For several years before their issuance in 1941 and 1942 the Committee on Abstracts and Bibliography, C. J. West, Chairman, A. Papineau-Couture, and John F. Ohlson, reviewed the literature, and prepared abstracts were published in the *Paper Trade Journal*. However, with the increase in technical progress it became more difficult to find space in the Journal to keep the record up to date. Consequently, the Executive Committee decided that the Association would issue the abstracts as a separate publication. The abstracts were well received but because of lack of time for the committee to prepare the copy this Association service was discontinued.

TAPPI FIBRARY

At the First Testing Conference which was held at the Mellon Institute in Pittsburgh, Pa., Oct. 11–14, 1948, the desire was expressed that, at some place, there should be a collection of all the various fibers used in the manufacture of paper to which those interested in fiber analysis could refer. A questionnaire was sent to all the members of the Association to determine the degree of interest and also those firms or individuals who could furnish samples. As a result of an affirmative response, collection efforts were initiated in October, 1949, and the TAPPI Fibrary established at The Institute of Paper Chemistry in Appleton, Wis.

The samples, there being 390 listed to date, are fully attested as to species and process by which they are pulped. A representative specimen may be obtained from the Fibrary at a nominal cost.

The Fibrary is not considered to be complete, there being many fibers that are needed. Consequently, continued efforts are being made to enlarge the collection and so increase its value to the industry.

TAPPI COMMITTEES

From the beginning the real work of the Technical Association has been carried on by its standing committees. The detailed history of the accomplishments of these groups is recorded in the proceedings published in *Technical Association Papers* and in *Tappi*. In fact, the tremendous number of meeting papers published in these volumes as well as in the various trade papers were the result of the prodigious efforts of the committees and particularly of their chairmen. Space will not permit a detailed report of the histories of these committees, nor their personnel, which in itself would entail the publication of a sizable portion of the membership roster. However, appreciation of their accomplishments is gratefully acknowledged by the Association.

The development of the committee organization has been one of normal growth. As the need has arisen committees have been organized and their objectives specified. The present organization represents the refinement of a program brought to a systematic arrangement during the presidential administration of M. A. Krimmel of the Hammermill Paper Co. in 1930. Prior to 1930 all the committees existed as independent units. In 1930 Mr. Krimmel offered a plan whereby committees having a general common interest were grouped into divisions, each having a general chairman to serve in an administrative capacity. This system has worked out very successfully and has simplified the administration of committee activities to a great extent.

In general the committees have the following responsibilities: (1) to maintain a competent personnel; (2) to determine suitable projects on which to focus attention; (3) to assist in the preparation of special reports on manufacturing problems; (4) to assist in the preparation of data sheets; (5) to establish standard testing methods, specifications, recommended practices and suggested methods; (6) to prepare monographs on technical subjects; (7) to prepare programs for annual and fall meetings and (8) to assist the headquarters staff in responding to technical inquiries.

There are, at present, seven major committee divisions, namely: Engineering, Industrial, Pulp Manufacture, Paper Manufacture, Research Development, Converting and Consuming, and Testing. Their present committees and functions are given below.

Engineering Division

Steam and Power Committee—The generation, distribution, and application of energy, the study of fuels, and the training of power engineers.

Industrial Engineering and Materials Handling Committee—The mechanical handling of wood, fibrous and nonfibrous materials in the dry or semidry state.

Drying and Ventilating Committee—The study of the drying rates for pulp, paper, and paperboard and of the utilization of air for mill heating and ventilating.

Engineering Research and Machine Design Committee—The fundamental study of mechanical engineering unit operations and equipment.

Mill Planning and Economics Committee—Engineering and economic considerations relative to mill location, construction, and choice arrangement of equipment and service utilities.

Mill Maintenance and Materials Committee—The development and interchange of information regarding maintenance practice and equipment construction materials.

Chemical Engineering Committee—The study of the unit operations of chemical engineering as applied to process developments and plant equipment design. The study of corrosion.

Hydraulics Committee—The study of stock flow in pipes.

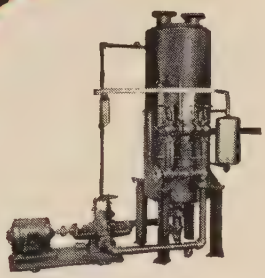
Electrical Engineering Committee—Electrical distribution and application.

Sanitary Engineering Committee—Engineering methods pertaining to water and waste treatment.

Industrial Division

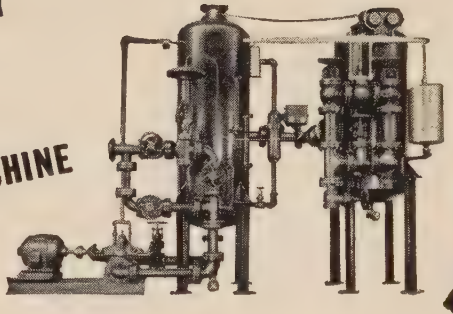
Nonfibrous Raw Materials Committee—The sources, procurement, transportation, storage, economics, and specifications of nonfibrous raw materials.

Training and Education Committee—The promotion and development of educational programs for per-



FOR THE SMALL MACHINE

FOR THE BIG MACHINE



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sonnel engaged in, or in training for, activities pertaining to the manufacture of pulp, paper, and related products.

Mill Instrument Control Committee—The design, application, and maintenance of instruments used in the mill to measure and control pressure, temperature and other operating variables.

Water Committee—The physical and chemical properties of water for pulp, paper, and paperboard use.

Fibrous Agricultural Residues Committee—The sources, procurement, and processing of products such as paper and boards from straw and other fibrous agricultural residues.

Structural Fibrous Materials Committee—The processes of forming cellulose fibers into insulating and similar thick boards and their evaluation both as to raw materials and finished products.

Converting and Consuming Division

Corrugated Containers Committee—The processes of conversion to corrugated containers.

Container Evaluation and Development Committee—Nomenclature definition of terms, test methods, performance specifications and study of the effect of various factors, influencing strength and serviceability relating to packaging, including packages, shipping containers and pallets, and the physical methods of testing container boards.

Graphic Arts Committee—The process of printing and the subsequent operation of folding, stapling, stitching, assembling, and binding.

Coating Committee—The processes of coating paper or paperboard with casein, starch, glue, gums, waxes, varnishes, cellulose, esters, pigments and other materials.

Plastics Committee—The problems of evaluation, processing, or utilization arising from the combination of pulp and paper products with plastic substances or from their conversion into plastic materials.

Wet Strength and Interfiber Bonding Committee—The study of testing methods and instruments useful in the evaluation of the wet strength of paper; development control methods relating to the preparation of wet-strength papers; study of the use requirements of wet-strength papers.

Research Development Division

Bibliography Committee—The preparation of an annual list of periodical and patent literature on pulp and paper manufacture.

Fundamental Research Committee—The prosecution of fundamental research and the organization and administration of research departments.

Patents Committee—The procedure, legislation, and decisions relative to patents.

Statistics Committee—The application of statistical methods to the analysis of test data. Study of application of quality control methods to pulp and paper manufacture.

Microbiological Committee—The establishment of methods for the evaluation of microbiological control in the pulp and paper industry.

Pulp Manufacture Division

Acid Pulping Committee—The processes of acid liquor making and wood digestion, and subsequent riffling, screening, washing, and thickening prior to stuff preparation.

Alkaline Pulping Committee—The processes of alkaline pulping and chemical recovery and subsequent riffling, screening, washing, and thickening prior to stuff preparation.

Mechanical Pulping Committee—The processes of mechanical and semichemical pulping, and subsequent riffling, screening, washing, thickening, and bleaching prior to stuff preparation.

Semichemical Pulping Committee—The processes of mechanical and semichemical pulping, and subsequent riffling, screening, washing, thickening, and bleaching prior to stuff preparation.

Paper Deinking Committee—The processes of chemical and mechanical treatment of old papers and subsequent riffling, screening, and washing prior to stuff preparation.

Pulp Purification Committee—The processes of bleaching pulp and the treatment of pulp at the mill for chemical conversion processes.

Dissolving Pulps Committee—The relations of variations in wood quality within and between species affecting pulp and product characteristics, the influence of the pulping and purification processes and their variables on pulp and product characteristics, and methods for evaluating the effects of these variables.

Chemical Products Committee—The processes of utilizing, refining, and testing the byproducts of chemical pulping, such as tall oil, turpentine, and lignin.

Paper Manufacture Division

Preparation of Papermaking Materials Committee—The processes of preparing all materials for the papermaking operation, involving such materials as papermaking fibers, size, colors, alum, and starch, but not including preparation processes usually carried out in wood pulp manufacturing departments.

Fourdrinier Committee—The processes of mechanical preparation of fibers prior to the paper machine and the details concerning the manufacture of paper and paperboard on fourdrinier types of paper machines.

Cylinder Board Committee—The processes of mechanical preparation of fibers prior to the paper machine and the details concerning the manufacture of paper and paperboard on cylinder types of paper machines.

Testing Division

Fibrous Materials Testing Committee—The physical methods of evaluating all fibrous raw materials used in the manufacture of pulp and paper.

Nonfibrous Materials Testing Committee—The physical and chemical methods of evaluating nonfibrous raw materials such as alum, casein, etc.

Pulp Testing Committee—The physical methods of evaluating all kinds of pulp.

Chemical Methods Committee—The chemical methods of testing wood, pulp, paper, and other fibrous materials.

Microscopy Committee—The microscopical methods of testing fibrous and nonfibrous materials.

Optical Properties Committee—The optical methods of testing fibrous materials.

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Container Testing Committee—The physical methods of testing heavy containers and containerboard.

Packaging Materials Testing Committee—The physical methods of evaluating packaging materials and packages other than heavy containers, made of such materials.

Paper Testing Committee—The physical methods of evaluating paper and paperboard, except containerboard.

Wax Testing Committee—The physical methods of testing waxes.

Miscellaneous Committees

Joint Textbook Committee—Messrs. Jones and Spencer represent the Canadian pulp and paper industry and Messrs. Macdonald, Hatch, and Kellogg represent the industry in the United States. This committee is responsible for financing, editing, and revising the textbooks on the Manufacture of Pulp and Paper, published by the McGraw-Hill Book Co.

Liaison with Other Societies—The Association maintains interlocking relations with organizations such as the Am. Soc. for Testing Materials, National Assoc. of Corrosion Engineers, Inter-Society Color Council, Am. Soc. Mechanical Engineers, and many others wherein technical problems common to both organizations require joint attention.

TAPPI Committee Chairmen

The following list of division and committee chairmen, taken from the secretary's 1954 report, indicates the present scope of committee interest and industry cooperation.

Engineering Division: John D. Lyall, Armstrong Cork Co., Lancaster, Pa., succeeded C. J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y., as general chairman of the division during the Engineering Conference held in October. W. C. Bloomquist, General Electric Co., Schenectady, N. Y., continued as general secretary; *Steam and Power Committee:* W. Wyburn, Federal Paperboard Co., Bogota, N. J., chairman, V. P. Owens, Combustion Engineering Co., New York, N. Y., succeeded J. Gottlieb, Westinghouse Electric Corp., New York, N. Y., as secretary; *Materials Handling Committee (now the Industrial Engineering and Materials Handling Committee)*: J. M. MacBrayne, Union Bag & Paper Corp., Savannah, Ga., succeeded W. R. McNally, Link-Belt Co., Pittsburgh, Pa., as chairman; H. A. Stoess, Jr., Fuller Co., Catasauqua, Pa., continued as secretary; *Drying and Ventilating Committee:* C. A. Young, Riegel Paper Corp., Milford, N. J., chairman, and R. M. Cook, Ross Midwest Fulton, Inc., Dayton, Ohio, secretary; *Engineering Research and Machine Design Committee:* R. G. Quinn, Johns-Manville Research Corp., Manville, N. J., chairman, and R. D. Irwin, Brown Instrument Division, Minneapolis-Honeywell Co., Philadelphia, Pa., secretary. This committee has three subcommittees. *Centralized Control of Stock Systems Subcommittee:* Lester J. Tarbell, Bird & Son, East Walpole, Mass., chairman; *Correlation of Various Types of Plastometers Subcommittee:* K. W. Brenner, Eastman Kodak Co., Rochester, N. Y., chairman; and *Machine Design Data Subcommittee:* George E. Clink, Sandy Hill Iron & Brass Works, Hudson Falls, N. Y., chairman; *Mill Planning and Economics Committee:* R. A. Packard, Hopkinton, Mass., chairman, and P. A. Forni, Mohawk Paper Mills, Cohoes, N. Y., secretary. This committee has two subcommittees: *Mill Location Design and Construction Subcommittee:* M. C. Celli, Celli-Flynn, McKeesport, Pa., chairman; *Processes, Utilities, and Mill Operating Subcommittee:* S. H. Grimnes, Diamond Match Co., Plattsburg, N. Y., chairman; *Hydraulics Committee:* K. J. Mackenzie, Eastman Kodak Co., Rochester, N. Y., chairman; *Mill Maintenance and Materials Committee:* L. L. Mrachek, Mead Corp., Kingsport, Tenn., succeeds George F. Hrubecky (deceased) and H. F. Parker, New York & Pennsylvania Co., Lock Haven, Pa., acting chairmen. H. K. Kingsbury, Allis-Chalmers Mfg. Co., continues as secretary. *Electrical Engineering Committee:* M. J. Osborne, Bowaters Southern Paper Co., Calhoun, Tenn., succeeded Ray W. Foster, Champion Paper & Fibre Co., Canton, N. C., as chairman; J. L. Van Norte, Reliance Electric & Engineering Co., Cleveland, Ohio, continues as secretary. This committee has four subcommittees. *Motor Characteristics Subcommittee* and *Downtime on Electrical Sectional Drive Subcommittee:* R. F. Sorenson, Union Bag & Paper Corp., Savannah, Ga., chairman; *Cable Subcommittee:* A. E. Mortenson, St. Regis Paper Co., Pensacola, Fla., chairman; *Chipper Drive Subcommittee* (work completed), M. J. Osborne chairman; *Chemical Engineering Committee:* L. C. Jenness, University of Maine, Orono, Me., succeeded J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga., as chairman. H. O. Teeple, International Nickel Co., New York, N. Y., continues as secretary. The status of the *Digester Corrosion Subcommittee* was changed to the *Corrosion Committee:* S. J. Baisch, Thilmany Pulp & Paper Co., Kaukauna, Wis., succeeded N. Shoumatoff, West Virginia Pulp & Paper Co., New York, as chairman. H. O. Teeple continues as secretary; *Data Sheets Committee:* J. W. Hemphill, Johns-Manville Sales Co., New York, N. Y., chairman.

Research Development Division: George A. Day, Brown Co., Berlin, N. H., succeeded W. F. Holzer, Crown Zellerbach Corp., as general chairman. *Bibliography Committee:* J. Weiner, Institute of Paper Chemistry, Appleton, Wis., was appointed chairman to fill vacancy existing since chairmanship of C. J. West (deceased). *Fundamental Research Committee:* Harry F. Lewis, Institute of Paper Chemistry, Appleton, Wis., chairman, *Statistics Committee:* John F. Langmaid, Jr., S. D. Warren Co., Cumberland Mills, Me., chairman. *Microbiological Committee:* B. F. Shema, Institute of Paper Chemistry, Appleton, Wis., chairman. *Microbiological Monograph Subcommittee:* J. W. Appling, Buckman Laboratories, Memphis, Tenn., chairman. *Testing of Fungus Resistance Subcommittee:* B. F. Shema, chairman. *Patents Committee:* Frank Makara, patent attorney, New York, N. Y., chairman.

Industrial Division: Roy L. Davis, Scott Paper Co., Detroit, Mich., succeeded Norman I. Bearse, Champion-International Co., as general chairman. *Training and Education Committee:* No chairman appointed. *Cost Engineering Committee:* A. E. Bachmann, Missisquoi Corp., Sheldon Springs, Vt., chairman. *Nonfibrous Raw Materials Committee:* E. N. Poor, Hudson Pulp and Paper Co., Augusta, Me., chairman. *Mill Instrument Control Committee:* No chairman. *Water Committee:* A. S. Erspamer, Hollings-

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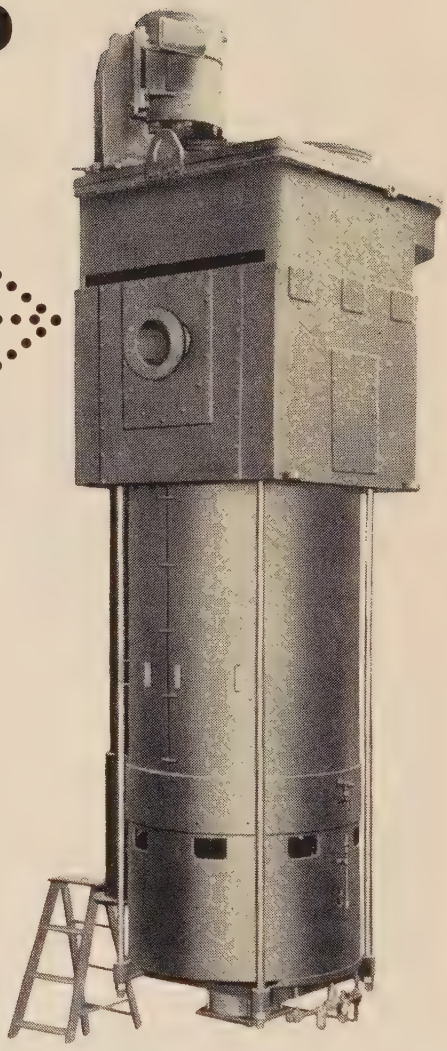

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worth & Whitney Div., Scott Paper Co., Waterville, Me., chairman. There are four subcommittees. *Analytical and Testing Methods Subcommittee:* W. A. Tanzola, W. H. & L. D. Betz, chairman. *Special Projects Subcommittee:* E. N. Poor, chairman. *Water Supply and Treatment Subcommittee:* H. J. Skinner, Boston, Mass., chairman. *White Water Utilization and Waste Disposal Subcommittee:* C. C. Porter, Southland Paper Mills, Lufkin, Tex., chairman. *Fibrous Agricultural Residues Committee:* S. I. Aronovsky, Northern Regional Research Laboratory, Peoria, Ill., chairman. There are five subcommittees. *Procurement, Storage and Preservation Subcommittee:* H. M. Blandin, Central Fibre Products Co., Quincy, Ill., chairman. *Raw Materials Classification Subcommittee:* S. I. Aronovsky, chairman. *Pulping Subcommittee:* J. R. Little, Hinde & Dauch Paper Co., Sandusky, Ohio, chairman. *Board and Paper Manufacture Subcommittee:* M. F. Knack, River Raisin Paper Co., Monroe, Mich., succeeded R. F. Burns, Weston Paper & Mfg. Co., Terre Haute, Ind., as chairman. *Testing Subcommittee:* W. L. Cassiday, Alton Boxboard Co., Alton Ill., chairman. *Structural Fibrous Materials Committee:* R. G. Lacey, The Celotex Co., Marero, La., succeeded T. C. Duval (deceased), Wood Conversion Co., Cloquet, Minn., who was appointed early in 1954 to succeed E. M. Jenkins, Johns-Manville Research Center. There are two subcommittees. *New Projects and Review Subcommittee:* J. O. Burton, Minnesota & Ontario Paper Co., International Falls, Minn., chairman. *Paper, Publication, and Review Subcommittee:* J. F. Campbell, Flintkote Co., Meridian, Miss., chairman. *Test Board Formation Subcommittee:* R. G. Lacey, chairman. *Drainage Time Testing Subcommittee:* J. J. Perot, Flintkote Co., Whippany, N. J., chairman. *Transverse and Deflection Testing Subcommittee:* J. F. Campbell, chairman. *Water Absorption, Water Penetration, and Water Vapor Permeability Subcommittee:* A. T. Walton, Simpson Logging Co., Shelton, Wash., chairman. *Nail Handling and Racking Test Subcommittee:* E. J. Jones, Celotex Co., Chicago, Ill., succeeded T. C. Duval (deceased) as chairman. *Light Reflection Measurements Subcommittee:* W. L. Scott, Armstrong Cork Co., Lancaster, Pa., chairman. *Consistency Measurements of Insulating Board Pulp Subcommittee:* A. H. Chamberlain, Bird & Son, E. Walpole, Mass., chairman. *Test Board vs. Hands Sheets for Board Pulp Evaluation Subcommittee:* R. J. Shouvlin, Bauer Bros. Co., Springfield, Ohio, succeeded C. K. Textor of the same company as chairman.

Converting and Consuming Division: F. D. Long, Container Corp. of America, Chicago, Ill., succeeded L. K. Burnett, Ohio Boxboard Co., as general chairman. *Corrugated Containers Committee:* Burt Mendlin, Cornell Paperboard Products, Inc., Milwaukee, Wis., chairman. There are five subcommittees. *Combining Subcommittee:* J. J. Koenig, Gaylord Container Corp., St. Louis, Mo., chairman. *Adhesives Subcommittee:* T. C. West, Southwest Corrugated Box Co., Fort Worth, Tex., chairman. *Waste Subcommittee:* F. D. Long, chairman. *Printing Subcommittee:* D. P. McNelly, Fort Wayne Corrugated Paper, Rochester, N. Y., chairman. *Finishing Subcommittee:* D. Arbuthnot, Fiber Board Container Corp., Richmond, Va. *Graphic Arts Committee:* C. A. Morton, West Virginia Pulp and Paper Co., Chicago, Ill., chairman. *Coating Committee:* R. T. Trelfa, Watervliet Paper Co., Watervliet, Mich., chairman. There are three subcommittees. *Raw Stock Subcommittee:* G. S. McKnight, Oxford Paper Co., Rumford, Me., chairman. *Research Subcommittee:* N. F. Kennedy, Corn Industries, Research Foundation, New York, N. Y., chairman. *Starch Monograph Subcommittee:* J. P. Casey, A. E. Staley Mfg. Co., Decatur, Ill., chairman. *Wet Strength Committee:* K. W. Britt, Scott Paper Co., Chester, Pa., chairman. *Plastics Committee:* R. T. Nazzaro, Westfield River Paper Co., Russell, Mass., chairman. There are three subcommittees. *Fibrous Materials for Laminated Products Subcommittee:* P. M. Goodloe, Brown Co., Berlin, N. H., chairman. *Plastics in Paper Converting Subcommittee:* J. C. Pullman, American Cyanamid Co., Stamford, Conn., chairman. *Resin Analysis Subcommittee:* S. E. Church, New York State College of Forestry, Syracuse, N. Y., chairman.

Pulp Manufacture Division: R. I. Thieme, Scott Paper Co., Anacortes, Wash., succeeded G. A. Day, Brown Co., as general chairman. *Acid Pulping Committee:* N. S. Lea, Soundview Div., Scott Paper Co., Everett, Wash., suceeded E. H. Woodruff, Rayonier, Inc., as chairman. *Alkaline Pulping Committee:* M. B. Pineo, Brunswick Pulp & Paper Co., Brunswick, Ga., succeeded F. W. Bishop, Southland Paper Mills, as chairman. There are three subcommittees. *High Yield Kraft Lignin-Chlorine Member Correlation Subcommittee:* P. B. Borlew, National Container Corp., Jacksonville, Fla., chairman. *Testing Procedures Subcommittee:* R. H. Stevens, Herty Foundation, Savannah, Ga., chairman. *Bibliography Subcommittee:* M. B. Pineo, chairman. *Semichemical Pulping Committee:* J. N. McGovern, Parsons & Whittemore Co., New York, N. Y., chairman. There are four subcommittees. *Equipment Survey Subcommittee:* J. E. Sapp, Gaylord Container Corp., Bogalusa, La., chairman. *Semichemical Pulping Measures Subcommittee:* R. W. Brown, Hammermill Paper Co., Erie, Pa., chairman. *Standard Terms Subcommittee:* C. K. Texter, Bauer Bros. Co., Springfield, Ohio, chairman. *Bibliography and Review Subcommittee:* J. N. McGovern, chairman. *Mechanical Pulping Committee:* F. W. O'Neil, New York State College of Forestry, Syracuse, N. Y., chairman. *Chemical Products Committee:* Arthur Pollak, consultant, New York, N. Y., chairman. *Paper Deinking Committee:* J. J. Forsythe, International Paper Co., Niagara Falls, N. Y., chairman. *Pulp Purification Committee:* W. H. Rapson, University of Toronto, Toronto, Ont., Canada, chairman. *Dissolving Pulps Committee:* F. A. Simmonds, Forest Products Laboratory, Madison, Wis., chairman. There are three subcommittees. *Viscose Subcommittee:* Sydney Coppick, American Viscose Co., Marcus Hook, Pa., chairman. *Acetate Subcommittee:* No chairman. *Nitrate Subcommittee:* No chairman.

Paper Manufacture Division: Harry C. Moore, Beloit Iron Works, Beloit, Wis., succeeded R. P. Price, Hammermill Paper Co., as general chairman. *Preparation of Papermaking Materials Committees:* F. S. Klein, Byron Weston Co., Dalton, Mass., chairman. There are three subcommittees. *Fillers Monograph Subcommittee:* R. J. Proctor, West Jersey Paper Co., Camden, N. J., chairman. *Significance of Sizing Tests Sub-*

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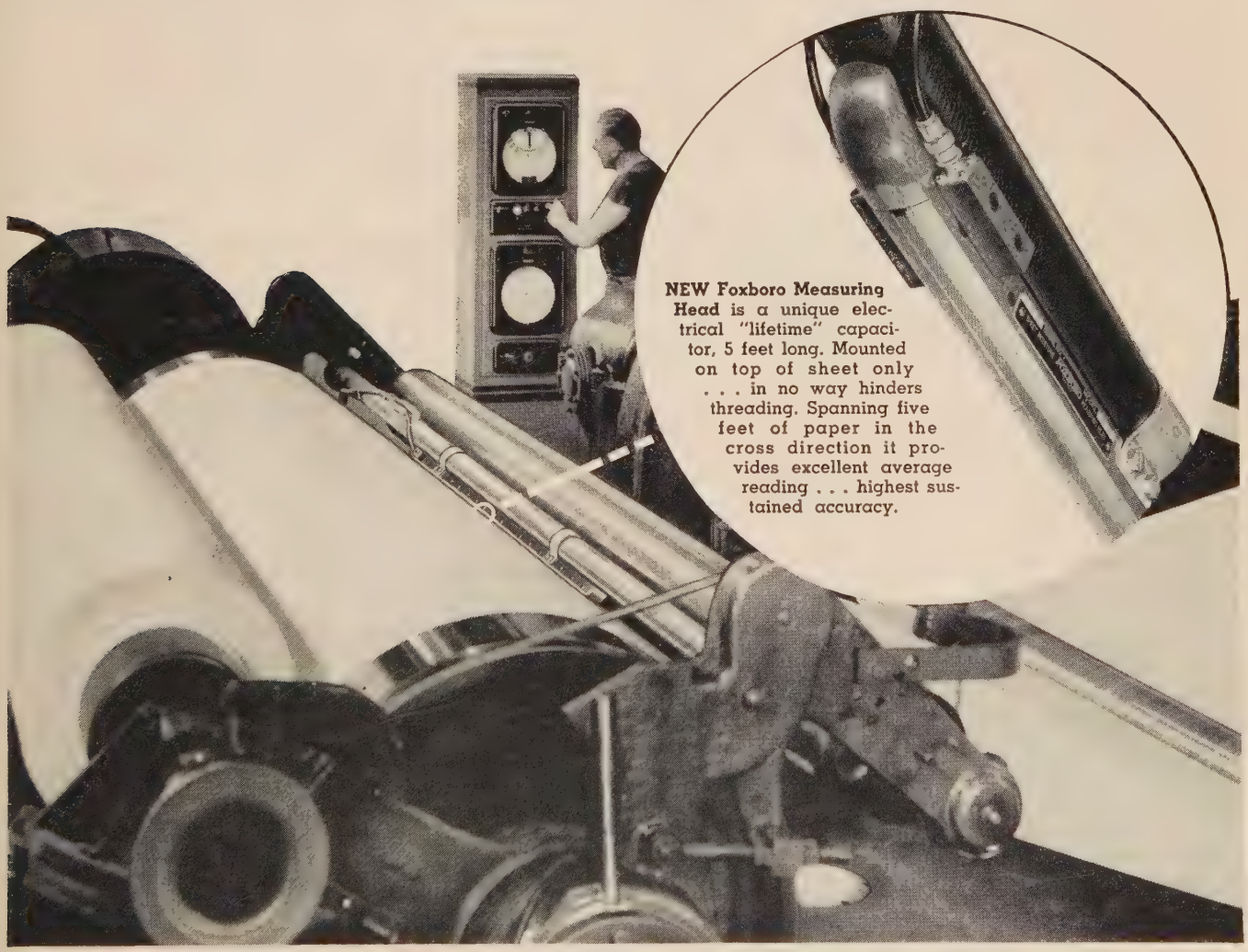

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FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

committee: R. G. Mispley, Crown Zellerbach Corp., Camas, Wash., chairman. *Additives Subcommittee:* R. W. Kumler, Waste Paper Utilization Council, New York, N. Y., chairman. *Cylinder Board Committee:* Glen Renegar, Container Corp. of America, Manayunk, Pa., chairman. *Fourdrinier Committee:* N. R. Phillips, Riegel-Carolina Paper Co., Acme, N. C., chairman. *Tissue Subcommittee:* L. P. Thompson, Personal Products Co., Milltown, N. J., chairman.

Testing Division: J. P. Casey, A. E. Staley Mfg. Co., Decatur, Ill., general chairman. *Fibrous Materials Testing Committee:* E. R. Schafer, Forest Products Laboratory, Madison, Wis., chairman. *Nonfibrous Materials Testing Committee:* K. H. Williams, Mid-States Gummed Paper Co., Chicago, Ill., succeeded J. R. Lyon, Atlas Boxmakers, Inc., chairman. There are seven subcommittees: *Testing of Enzymes Subcommittee:* Alexander Frieden, Pabst Research Laboratories, Milwaukee, Wis., chairman. *Testing of Tosin and Rosin Size Subcommittee:* T. S. Morse, Hercules Powder Co., Wilmington, Del., chairman. *Testing of Clays Subcommittee:* C. G. Albert, Edgar Div., Minerals & Chemicals Corp., McIntyre, Ga., chairman. *Testing of Casein Subcommittee:* D. B. Laird, The Borden Co., Bainbridge, N. Y., chairman. *Testing of Coating Starches Subcommittee:* C. C. Kesler, Penick & Ford Ltd., Cedar Rapids, Iowa, chairman. *Testing of Opaque Pigments Subcommittee:* W. R. Willets, Titanium Pigment Corp., New York, N. Y., chairman. *Testing of Animal Glues Subcommittee:* K. H. Williams, Mid-States Gummed Paper Co., chairman. *Wax Testing Committee:* G. C. Borden, Riegel Paper Corp., Milford, N. J., succeeded A. M. Heald, Scott Paper Co., as chairman. *Pulp Testing Committee:* F. E. Caskey, Morden Machine Co., Portland, Ore., chairman. *Optical Properties Committee:* H. E. Obermanns, Hammermill Paper Co., Erie, Pa., chairman. *Microscopy Committee:* C. E. Brandon, Howard Paper Mills, Dayton Ohio, chairman. *Paper Testing Committee:* D. H. Newcomb, Riegel Paper Corp., Warren Glen, N. J., chairman. There are nine subcommittees: *Erasing Properties Subcommittee:* P. W. Codwise, Beaver Wood Fibre Co., Thorold, Ont., chairman. *Wax Test for Surface Strength of Paper Subcommittee:* B. L. Wehmhoff, West Virginia Pulp & Paper Co., Chevy Chase, Md., chairman. *Thickness of Thin Paper Subcommittee:* P. F. Wehmer, Electrical Testing Laboratories, New York, N. Y., chairman. *Thickness and Bulk of Tissue Subcommittee:* J. T. Ward, Riegel Paper Corp., Milford, N. J., chairman. *Thickness and Bulking of Book Paper Subcommittee:* B. L. Wehmhoff, chairman. *Water Resistance of Paper Subcommittee:* R. B. Hobbs, National Bureau of Standards, Washington, D. C., chairman. *Dirt in Paper Subcommittee:* R. H. Wiles, International Paper Co., Glens Falls, N. Y., chairman. *Rigidity, Stiffness, and Softness of Paper Subcommittee:* E. F. McCarty, Minneapolis, Minn. *Turpentine Test for Grease Resistance Subcommittee:* S. C. Fairbanks, Hamersley Paper Co., Garwood, N. J., chairman. *Container Testing Committee:* Milton Yezek, General Foods Corp., Battle Creek, Mich., succeeded C. H. Krebs, Atlas Boxmakers, Inc., as chairman. *Packaging Materials Testing Committee:* W. H. Aiken, Gardner Board & Carton Co., Middletown, Ohio, chairman. There are four subcommittees. *Water Vapor Permeability Subcommittee:* T. E. Dobbins, American Gas Co., Maywood, Ill., chairman. *WVP of Completed Packages Subcommittee:* C. M. Woodcock, General Foods Co., Hoboken, N. J., chairman. *Insect Resistance of Packages, Paper, and Paperboard Subcommittee:* H. S. Gardner, Fibreboard Products Inc., Antioch, Calif., chairman. *Flavor and Other Transfer Subcommittee:* A. H. Landrock, Olin Mathieson Chemical Co., New Haven, Conn., chairman. *Chemical Methods Committee:* A. S. O'Brien, Eastman Kodak Co., Rochester, N. Y., chairman. There are eight subcommittees. *Alpha, Beta, Gamma-Cellulose Subcommittee:* A. S. O'Brien, chairman. *Disperse Viscosity Subcommittee:* O. A. Battista, American Viscose Co., Marcus Hook, Pa., chairman. *Chain Length Distribution and Accessibility of Cellulose Subcommittee:* Geoffrey Broughton (deceased). No chairman appointed. *Pentosans in Highly Refined Pulps Subcommittee:* E. S. McColley, Celanese Corp. of America, Rock Hill, S. C. *Ash in Pulp Subcommittee:* R. H. Ramsey, Brown Co., Berlin, N. H., chairman. *Titanium in Paper Subcommittee:* C. H. Steinford, chairman. *Bleachability of Pulp Subcommittee:* Lyman Aldrich, West Virginia Pulp & Paper Co., Covington, Va. *Starch in Paper Subcommittee:* J. L. Harvey, National Bureau of Standards, Washington, D. C.

Special Committees: *Standards Committee:* R. C. Griffin, Needham, Mass., chairman. *Research Appropriations Committee:* J. L. Parsons, Waterville, Me., chairman. *Joint Textbook Committee:* Harry S. Spencer, Howard Smith Paper Mills, Beauharnois, P. Q., chairman. (This committee is responsible for the preparation of the industry's textbook, "Pulp and Paper Manufacture.") The other members of the committee are R. S. Hatch, Hudson Pulp & Paper Co., New York, N. Y.; R. G. Macdonald, TAPPI: Douglas Jones, CPPA Technical Section, and R. S. Kellogg, Brandenton, Fla.; J. N. Stephenson, *Pulp and Paper Magazine of Canada*, Gardenvale, P. Q., is editor.

TAPPI YEAR BOOK

While the TAPPI Year Book cannot be considered as a technical publication, it is in a sense, the bible of the Technical Association for it contains the procedures under which the Association operates. In addition to the Constitution and Bylaws it outlines the procedures for the operation of local sections and committees; gives the regulations for standards, *Tappi* manuscripts, and research requests; lists all the publications and services of the Association; has the current officers of the Association, its local sections, and committees; and finally a roster of TAPPI members. It has been published, more or less in its present form, since 1932.

TAPPI MEMBERSHIP

Prior to 1931, a list of members was included in *Technical Association Papers.* In 1931 it was published in a paper cover and in 1932 to date in the TAPPI Year Book.

The qualifications for membership are fully covered in the TAPPI Year Book and the members fall into one of three general classes: individual, corporate, and sustaining.

The Technical Association of the Pulp and Paper

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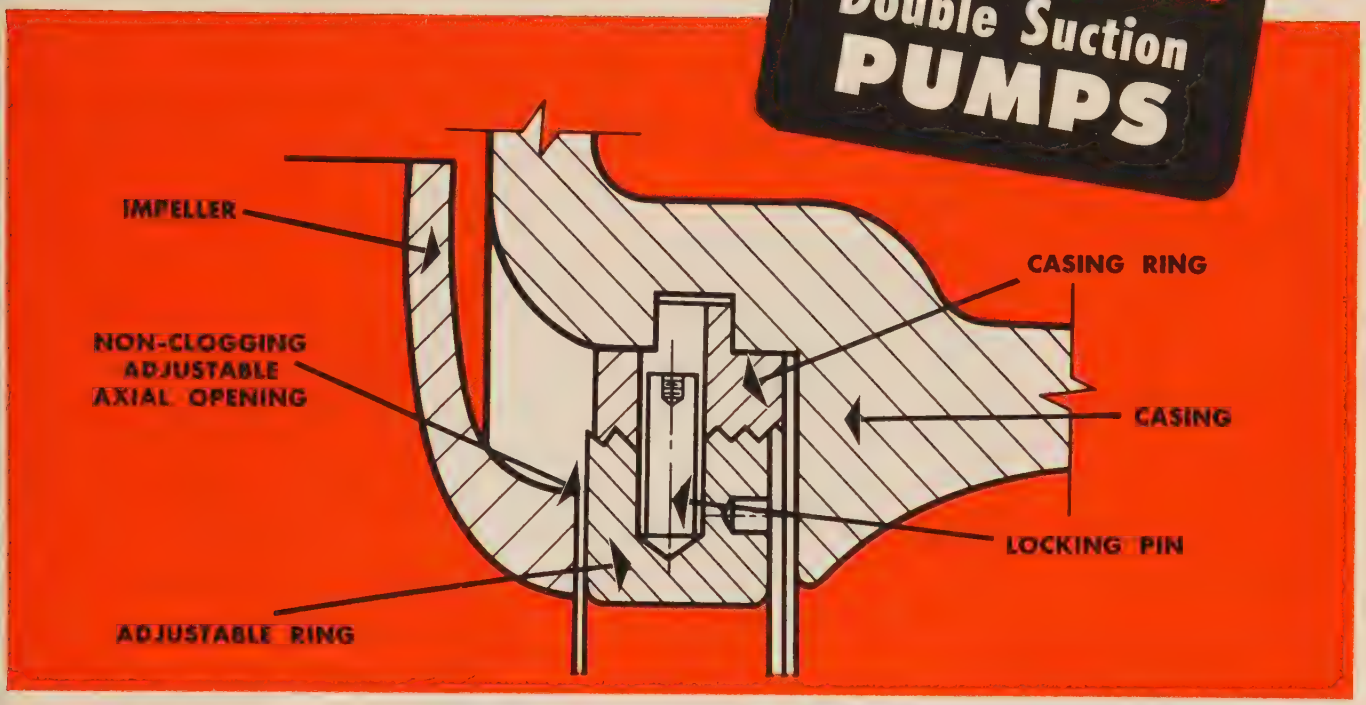
Double Suction
PUMPS



This wearing ring design pays off in Long Life... Low Maintenance

- ***You can compensate for wear***
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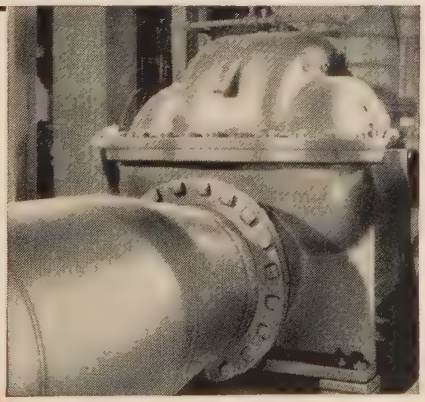
This unique Allis-Chalmers pump design features adjustable clearance wearing rings with an *axial* rather than a *radial* opening. It will cut your pump costs by keeping efficiency high in spite of wear and by preventing damage due to seizing of impeller by stock in the wearing ring clearance. Ideal for fan pump, white water, light stock, or small solids in suspension.



This 24 by 24 Type SK, 15,000-gpm, 30-ft head fan pump moves stock from wire pit to machine head box at Potlatch Forests, Inc., Lewiston, Idaho.

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To Adjust Clearance for Wear

Remove pin, turn threaded inner ring until clearance is correct, replace the pin. Correct clearances not only keep efficiency high but tend to exclude solids and eliminate clogging.

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Stainless steel wearing rings are carried in stock for 16 by 14 and smaller-sized pumps.

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Industry is the largest organization in the world (over 7000 members) of top executives, managers, superintendents, engineers, and technical men serving the industry.

Most of the members have degrees from colleges or institutes of technology and experience in the pulp and paper industry. Their motive in joining TAPPI is a desire to keep abreast of technological developments in their field through the medium of TAPPI publications, to participate in technical committee work, and to attend regional and national TAPPI meetings.

The individual membership consists of the following classes: active, associate, student, affiliate, and overseas. The following table indicates the growth of the Association over the past 40 years.

1915—201	1925— 674	1935—1244	1945—2288
1916—270	1926— 711	1936—1354	1946—2468
1917—325	1927— 761	1937—1521	1947—2821
1918—408	1928— 901	1938—1600	1948—3257
1919—475	1929—1033	1939—1645	1949—3615
1920—525	1930—1166	1940—1794	1950—4103
1921—346	1931—1198	1941—1867	1951—4679
1922—550	1932—1093	1942—1907	1952—5174
1923—571	1933—1068	1943—1926	1953—5693
1924—584	1934—1127	1944—2128	1954—6277

Corporate Members

The corporate members are paper companies who endorse the work of the organization and contribute toward its extension, financially. In return the Association gives these members special privileges, such as a right to be represented in voting opportunities and copies of the Special Reports on Manufacturing Problems. The latter are given only to the corporate members and to individuals who supply the information that is contained in the reports. Following are the corporate members as of September, 1955.

Albemarle Paper Co., Richmond, Va.
Alton Boxboard Co., Alton, Ill.
American Box Board Co., Grand Rapids, Mich.
American Writing Paper Corp., Inc., Holyoke, Mass.
Atenquique, Cia., Ind. de, Atenquique, Mexico
Atlanta Paper Co., Atlanta, Ga.
Australian Paper Manufacturers, Ltd., Princess Bridge, Melbourne, Victoria, Australia
Bare Paper Co., D. M., Roaring Springs, Pa.
Barrett Div., New York, N. Y.
Bartgis Bros. Co., The, Ilchester, Md.
Belgique, Papeteries de, Brussels, Belgium
Bengal Paper Mills Co., W. Bengal, India
Ben Mont Papers, Inc., Bennington, Vt.
Bergstrom Paper Co., Neenah, Wis.
Beveridge Paper Co., Indianapolis, Ind.
Bird & Son, East Walpole, Mass.
Blandin Paper Co., Grand Rapids, Minn.
Bloomer Bros. Co., Newark, N. Y.
Borregaard, A/K, Sarpsborg, Norway
Bowater's Newfoundland Pulp & Paper Mills Ltd., Corner Brook, Newfoundland, Canada
Bowaters Southern Paper Corp., Calhoun, Tenn.
British Paper and Board Industry Research Association, St. Winifred's Laboratories, Welcomes Rd., Kenley, Surrey, England
Brittains, Ltd., Cheddleton Paper Mills, near Leeks, Staffordshire, England
Brown Co., Berlin, N. H.
Brown Paper Co., L. L., Adams, Mass.
Brown Paper Mill Co., Inc., Monroe, La.
Brownville Paper Co., Brownville, N. Y.
Buntpapierfabric A/G, Aschaffenburg, Germany
Camp Manufacturing Co., Franklin, Va.
Cartiere Burgo, Torino, Italy
Celanese Corp. of America, New York, N. Y.
Cellulose du Pin, Facture, Gironde, France
Celulosa de Chihuahua, S. A., Chihuahua, Mexico
Celulosa de Filipinas, Bais, Negros Oriental, P. I.
Central Fibre Products Co., Quincy, Ill.
Champion-International Co., Lawrence, Mass.
Champion Paper & Fibre Co., Hamilton, Ohio
Chesapeake Corp. of Virginia, West Point, Va.
Chillicothe Paper Co., Chilicothe, Ohio
Clifton Paper Board Co., Inc., Clifton, N. J.
Clyde Paper Company, Ltd., Rutherglen, Scotland
Columbia Box Board Mills, Inc., Chatham, N. Y.
Columbia Cellulose Co., Prince Rupert, B. C.
Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.
Container Corp. of America, Chicago, Ill.
Continental Paper Co., Ridgefield Park, N. J.
Cooke & Nuttall, Ltd., Vale Paper Mills, Horwich, Lancashire, England
Cornell Paperboard Products Co., Cornell, Wis.
Corning Fibre Box Corp., Corning, N. Y.
Courtaulds-Alabama Inc., Mobile, Ala.
Courtaulds Ltd., Foleshill Road, Coventry, England
Cowan & Sons, Ltd., Alex, Valleyfield Mills, Ltd., Penicuik, Scotland
Crane & Co., Dalton, Mass.
Crossett Paper Mills, Crossett, Ark.
Crown-Zellerbach Corp., San Francisco, Calif.
Deerfield Glassine Co., Monroe Bridge, Mass.
De Forenede Papirfabrikker A/S., Copenhagen, Denmark
Dianda y Cia. Ltda., Sao Paulo, Brazil
Donside Paper Co. Ltd., Woodside, Aberdeen, Scotland
Downing Box Co., Milwaukee, Wis.
Downingtown Paper Co., Inc., Downingtown, Pa.
Dunn Paper Co., Port Huron, Mich.
Eastern Corp., Bangor, Me.
Ecusta Paper Corp., Pisgah Forest, N. C.
Erving Paper Mills, Erving, Mass.
Everett Pulp & Paper Co., Everett, Wash.
Federal Paper Board Co., Bogota, N. J.
Fibreboard Products, Inc., San Francisco, Calif.
Finch, Pruyn & Co. Inc., Glens Falls, N. Y.
Fleming & Sons Inc., Dallas, Tex.
Fletcher Paper Co., Alpena, Mich.
Follum Fabrikker A/S., Hoenefoss, Norway
Fort Wayne Corrugated Paper Co., Fort Wayne, Ind.
Fourdrinier Kraft Board Institute, Inc., New York, N. Y.
Fox River Paper Corp., Appleton, Wis.
Fraser Paper, Ltd., Edmundson, N. B.
French Paper Co., Niles, Mich.
Gair Co., Inc., Robert, New York, N. Y.
Gaylord Container Corp., Bogalusa, La.
Gilbert Paper Co., Menasha, Wis.
Glatfelter Co., P. H., Spring Grove, Pa.
Gould Paper Co., Lyons Falls, N. Y.
Grace & Co., W. R., New York, N. Y.
Great Northern Paper Co., Millinocket, Me.
Grycksbo Pappersbruk A/B., Grycksbo, Sweden
Guard Bridge Paper Co., Ltd., Guard Bridge, Fife, Scotland
Gulf States Paper Corp., Tuscaloosa, Ala.
Gummed Products Co., The, Troy, Ohio
Hartford City Paper Co., Hartford City, Ind.
Hawthorne Paper Co., Kalamazoo, Mich.
Hazen Paper Co., Holyoke, Mass.
Hoaque-Sprague Corp., West Hopkinton, N. H.
Hoberg Paper Mills, Inc., Green Bay, Wis.
Hollingsworth & Vose Co., East Walpole, Mass.
Holmens Bruks & Fabriks A/B, Norrkoping, Sweden
Hopper Paper Co., Taylorville, Ill.
Howard Paper Mills, Inc., Dayton, Ohio
Hudson Pulp & Paper Co., New York, N. Y.
Hummell-Ross Div., Continental Can Co., Hopewell, Va.
Hurlbut Paper Co., South Lee, Mass.
Imex S/A, Barcelona, Spain
Inland Empire Paper Co., Millwood, Wash.
Interlake Tissue Mills, Merritton, Ont.
International Paper Co., New York, N. Y.
Kajaani OY, Kajaani, Finland
Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich.
Keyes Fibre Co., Waterville, Me.
Kimberly-Clark Corp., Neenah, Wis.
Knowlton Bros. Co., Watertown, N. Y.
Lacroix Fils, L., Paris 4, France
Lawless Brothers Paper Mills, Inc., East Rochester, N. Y.
Lewis Co., J. P., Beaver Falls, N. Y.
Longview Fibre Co., Longview, Wash.
MacMillan & Bloedel Co., Ltd., Nanaimo, B. C.
Mac Sim Bar Paper Co., Otsego, Mich.
Marathon Corp., Rothschild, Wis.
Mead Corp., Chillicothe, Ohio
Menasha Wooden Ware Co., Menasha, Wis.
Millers Falls Paper Co., Millers Falls, Mass.
Minnesota & Ontario Paper Co., Minneapolis, Minn.
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Mohawk Paper Mills, Inc., Cohoes, N. Y.
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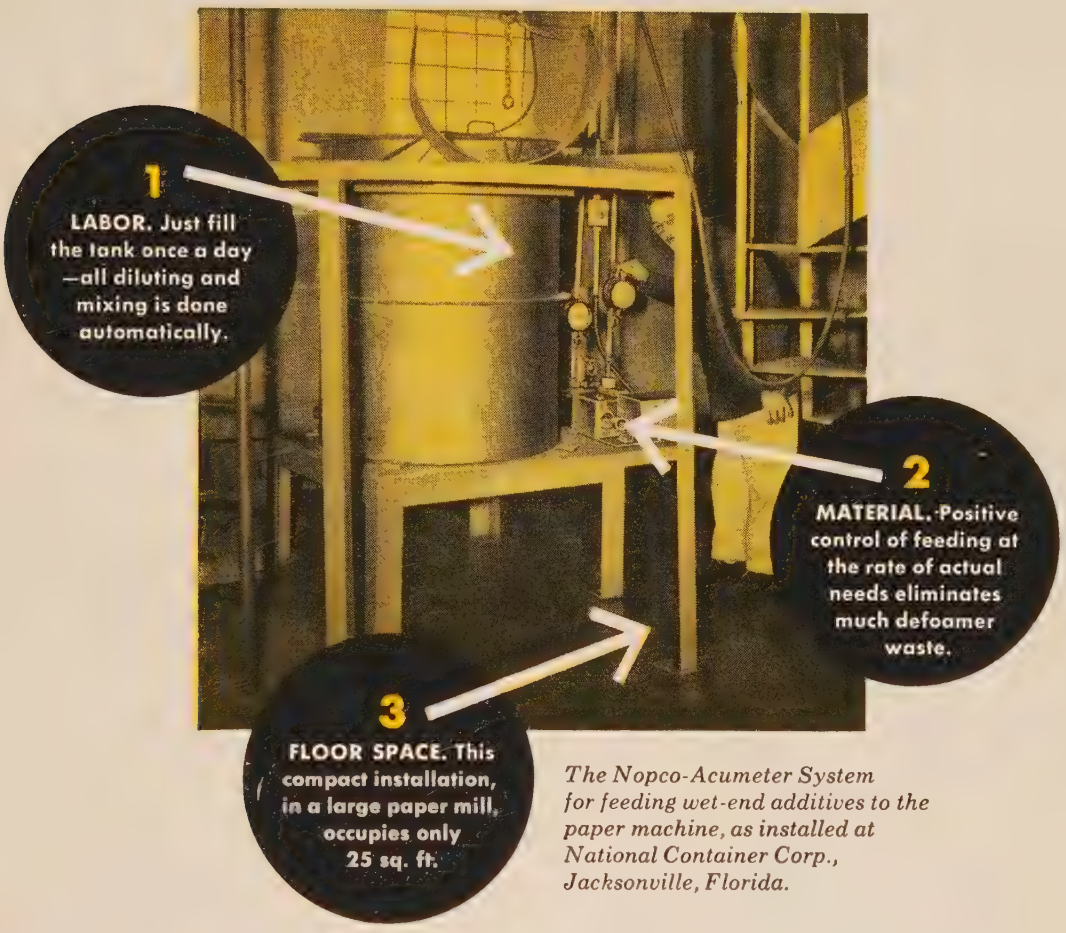
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LABOR. Just fill the tank once a day —all diluting and mixing is done automatically.
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MATERIAL. Positive control of feeding at the rate of actual needs eliminates much defoamer waste.
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FLOOR SPACE. This compact installation, in a large paper mill, occupies only 25 sq. ft.

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National Container Corp. of Wisconsin, Tomahawk, Wis.
National Gypsum Co., Research Div., Clarence Center, N. Y.
National Vulcanized Fibre Co., Yorklyn, Del.
New Haven Pulp & Board Co., New Haven, Conn.
Newton Falls Paper Co., Newton Falls, N. Y.
New York and Pennsylvania Co., Lock Haven, Pa.
N. Z. Forest Products, Ltd., Auckland, N. Z.
North Carolina Pulp Co., Plymouth, N. C.
Northwest Paper Co., Cloquet, Minn.
Ohio Boxboard Co., The, Rittman, Ohio
Ontario Paper Co., Thorold, Ont.
Orient Paper Mills, Ltd., Brajrajnagar, Sambalpur, India
Oswego Falls Corp., Fulton, N. Y.
Otsego Falls Paper Mills, Inc., Otsego, Mich.
Oulu Osakeyhtio, Oulu, Finland
Oxford Paper Co., New York, N. Y.
Pamer, Papelera Mercedes, S. A., Montevideo, Uruguay
Papeteries Steinbach & Co., S.A., Malmedy, Belgium
Parsons Paper Co., Holyoke, Mass.
Paterson Parchment Paper Co., Bristol, Pa.
Personal Products Corp., Milltown, N. J.
Poelser Zellulose-und Papierfabrik A/G., Poels, Austria
Potlatch Forests, Inc., Lewiston, Idaho
Powell River Co., Ltd., Vancouver, B. C., Canada
Premier Paper Mills, Transvaal, South Africa
Publishers' Paper Co., Oregon City, Ore.
Puget Sound Pulp and Timber Co., Bellingham, Wash.
Rayonier, Inc., Shelton, Wash.
Rhinelander Paper Co., Rhinelander, Wis.
Riegel Paper Corp., New York, N. Y.
River Raisin Paper Co., Monroe, Mich.
Robinson, E. S. & A. (Canada), Limited, Toronto, Ont.
Rogers Corp., Manchester, Conn.
Rolland Paper Co., Ltd., St. Jerome, Que.
Royal Container Co., San Francisco, Calif.
St. Anne's Board Mill Co., Ltd., Bristol, England
St. Croix Paper Co., Woodland, Me.
St. Marys Kraft Corp., New York, N. Y.
St. Regis Paper Co., Deferiet, N. Y.
Schmidt & Ault Paper Co., York, Pa.
Schweitzer, Inc., Peter J., New York, N. Y.
Scott Paper Co., Chester, Pa.
Shellmar Products Co., Mt. Vernon, Ohio
Shree Gopal Paper Mills Ltd., Calcutta, India
Societe Anonyme des Papeteries Darblay, Paris, France
Sorg Paper Co., The, Middletown, Ohio
Southern Advance Bag & Paper Co., Inc., Hodge, La.
Southland Paper Mills, Inc., Lufkin, Tex.
Star Paper Mills Ltd., Fenniscowles, England
Sterling Pulp & Paper Co., Eau Claire, Wis.
Stevenson & Sons, Ltd., London, England
Strange Paper Co., John, Menasha, Wis.
Strathmore Paper Co., Woronoco, Mass.
Sutherland Paper Co., Kalamazoo, Mich.
Temming, Peter A/S, Hamburg, Germany
Tennessee Paper Mills, Chattanooga, Tenn.
Thilmany Pulp & Paper Co., Kaukauna, Wis.
Titaghur Paper Mills Co., Calcutta, India
Tieleus Freres & Cia, Meerssen, Holland
Towgood, Edward & Sons, Ltd., Sawston, England
Union Bag & Paper Corp., Savannah, Ga.
Union des Papeteries, La Hulpe, Belgium
United Board & Carton Co., New York, N. Y.
Valentine Pulp & Paper Co., Lockport, La.
Van Gelder Zonen, Amsterdam, The Netherlands
Vita Mayer & Co., Monte Napoleone 9, Milano, Italy
Ward Paper Co., Merrill, Wis.
Warren Co., S. D., Boston, Mass.
Watervliet Paper Co., Watervliet, Mich.
Wausau Paper Mills Co., Brokaw, Wis.
Westfield River Paper Co., Russell, Mass.
Weyerhaeuser Timber Co., Longview, Wash.
Wiggins Teape & Co. Ltd., London, England
Wood Conversion Co., Cloquet, Minn.

Sustaining Members

The sustaining members are those companies in the allied industries that are interested in cooperating with the pulp and paper mill members in advancing the objectives of the Technical Association.

In addition to the financial support given, these companies have been exceedingly generous in giving the Association much of the time of their technical and sales engineering staffs both through participation in meetings, information, and even research service. Some companies have devoted much time and money to finance research activities in their establishments to obtain needed technical data. This information has been freely given to the pulp and paper industry through the medium of the Technical Association meetings, committees, and publications.

Although the motive of these companies in supporting an organization such as this is to develop and expand their market they have, for the most part, entered into the spirit of the organization and usually are represented in the Technical Association's activities by some of their best technically trained engineers and chemists, many of whom have had many years of practical mill operating and engineering experience in the pulp and paper industry prior to joining their sales and service staffs.

In return for this cooperation the Association gives advertising space in *Tappi* as well as the publications and other services of the Association.

Following are the sustaining members of the Technical Association in September, 1955:

Airkem, Inc., New York, N. Y.
Albany Felt Co., Albany, N. Y.
Allis Co., The Louis, Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Bitumuls Co., San Francisco, Calif.
American Brass Co., Waterbury, Conn.
American Cyanamid Co., New York, N. Y.
American Defibrator Co., New York, N. Y.
American Key Products, Inc., New York, N. Y.
Anheuser-Busch, Inc., St. Louis, Mo.
Appleton Machine Co., Appleton, Wis.
Appleton Wire Works, Appleton, Wis.
Appleton Woolen Mills, Appleton, Wis.
Arabol Mfg. Co., New York, N. Y.
Armstrong Machine Works, Three Rivers, Mich.
Asten-Hill Mfg. Co., Philadelphia, Pa.
Atlantic Refining Co., Philadelphia, Pa.
Babcock & Wilcox Co., New York, N. Y.
Bagley & Sewall Co., Watertown, N. Y.
Barrell Co., William L., Lawrence, Mass.
Bauer Bros. Co., Springfield, Ohio
Beloit Iron Works, Beloit, Wis.
Bensing Bros. & Deeney, Philadelphia, Pa.
Bird Machine Co., South Walpole, Mass.
Black-Clawson Co., Hamilton, Ohio
Bolton & Sons, Inc., John W., Lawrence, Mass.
Borden Co., Chemical Div., New York, N. Y.
Bowser, Inc., Fort Wayne, Ind.
Brown Instrument Co., The, Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Buckman Laboratories, Inc., Memphis, Tenn.
Buffalo Electro-Chemical Co., Inc., Buffalo, N. Y.
Bulkley, Dunton Pulp Co., New York, N. Y.
Cabble Wire Co., Brooklyn, N. Y.
Cameron Machine Co., Brooklyn, N. Y.
Carborundum Co., The, Niagara Falls, N. Y.
Carpenter Steel Co., Union, N. J.
Carthage Machine Co., Carthage, N. Y.
Cellulose Sales Co., Inc., New York, N. Y.
Chemipulp Process, Inc., Watertown, N. Y.
Cheney Bigelow Wire Works, Springfield, Mass.
Chicago Bridge & Iron Co., Chicago, Ill.
Chromium Corp. of America, New York, N. Y.
Ciba Company, Inc., New York, N. Y.
Clark-Aiken Co., The, Lee, Mass.
Cleary Corp., W. A., New Brunswick, N. J.
Cleaver-Brooks Co., Milwaukee, Wis.
Clinton Foods, Inc., Clinton, Iowa
Columbia-Southern Chemical Corp., Barberton, Ohio
Combustion Engineering, Inc., New York, N. Y.
Corn Products Refining Co., New York, N. Y.
Crane Co., Chicago, Ill.
Croll-Reynolds Co., New York, N. Y.
Crosby Chemical Co., De Ridder, La.
Crucible Steel Co., Pittsburgh, Pa.
Curlator Corp., Rochester, N. Y.

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STOCK REFINERS—For stock preparation with high freeness, high tear, and low horsepower, Bauer "Pump-Through" Refiner.

Literature on any of these machines will be gladly furnished.

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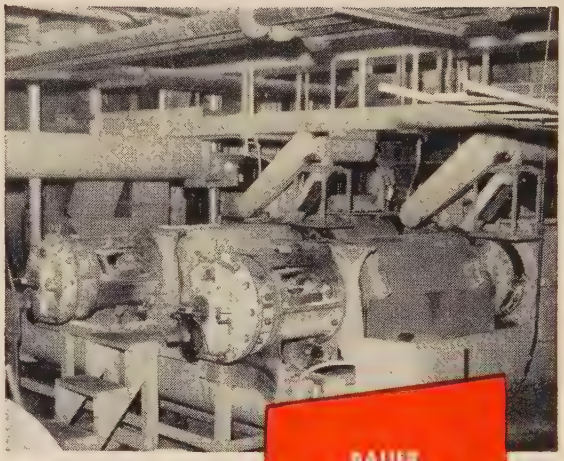
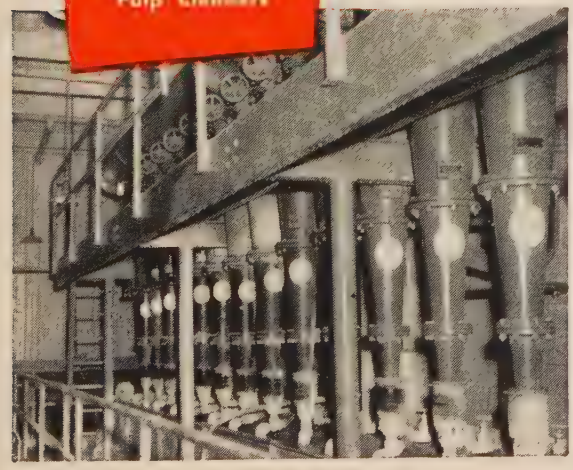
BAUER Rapid Cycle Digester

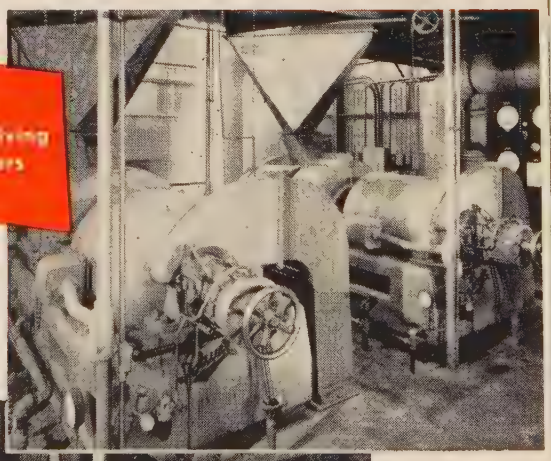


BAUER Pressafiners

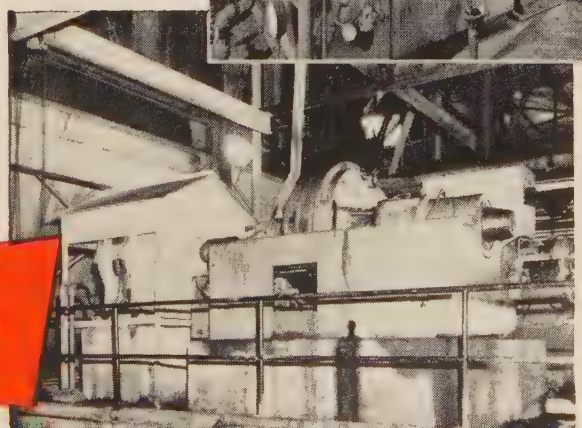
BAUER Pulp Cleaners



BAUER Double Revolving Disc Refiners



BAUER Pump-Through Refiner



De Laval Steam Turbine Co., Trenton, N. J.
DeZurik Shower Co., Sartell, Minn.
Diamond Alkali Co., Cleveland, Ohio
Dicalite Co., New York, N. Y.
Dorr Co., Stamford, Conn.
Dow Chemical Co., Midland, Mich.
Dowell, Inc., New York, N. Y.
Downingtown Mfg. Co., Downingtown, Pa.
Drackett Co., Cincinnati, Ohio
Draper Bros. Co., Canton, Mass.
du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.
Earl Paint Co., Utica, N. Y.
Eastwood-Nealley Corp., Belleville, N. J.
Ebasco Services, Inc., New York, N. Y.
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Egan & Co., Frank W., Bound Brook, N. J.
Electric Steel Foundry, Portland, Ore.
Elliott Co., Pittsburgh, Pa.
English China Clay Sales Corp., New York, N. Y.
Ethyl Corp., New York, N. Y.
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Rotareaed Corp., Bronxville, N. Y.
Rust Engineering Co., Pittsburgh, Pa.
Sandoz Chemical Co., New York, N. Y.
Sandy Hill Iron & Brass Works, Hudson Falls, N. Y.
Sandusky Foundry & Machine Co., Sandusky, Ohio
Semet-Solvay Div. (A. C. & D. Corp.), New York, N. Y.
Sheffield Corp., The, Dayton, Ohio
Shuler & Benninghofen Co., Hamilton, Ohio
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Sinclair Co., Holyoke, Mass.
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Sindar Corp., New York, N. Y.
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Smidth, F. L. & Co., New York, N. Y.
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Socony-Vacuum Oil Co., New York, N. Y.
Solvay Sales Div., Allied Chemical & Dye Corp., New York, N. Y.
Southern Clays, Inc., New York, N. Y.
Spencer Chemical Co., Kansas City, Mo.
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S & S Corrugated Machinery Co., Brooklyn, N. Y.
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• Whether you're using bleached and unbleached kraft or sulfite, ground wood, rag or mixtures of these pulps, Reichhold BECKAMINE P-841-30 can give you a high degree of wet strength. But there are *other* important contributions *this* resin can bring to your production. For example, P-841-30 also increases dry tensile and Mullen strength, and aids in the retention of clay, rosin size, starch, and other beater additives. This urea-formaldehyde, cationic type resin is usually applied after the refining operation at any convenient point, such as fan pump or head-box. If necessary, it can also be added at the beater. For complete information, write for Technical Bulletin P-3.

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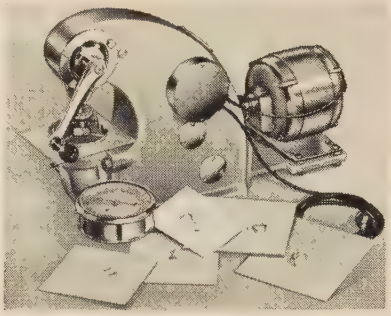

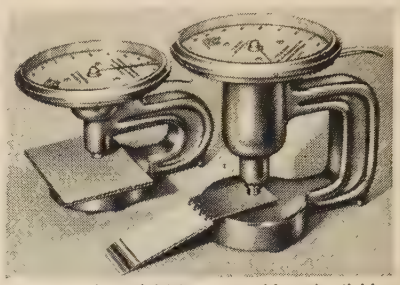

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Westinghouse Electric Corp., East Pittsburgh, Pa.
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It would be difficult in our modern life to be completely independent of paper or pulp in some form for even a few hours. Paper and pulp go into school books, newspapers, magazines, business forms, milk containers, wrapping paper, cellophane, grocery bags, fruit wrappers, paperboard cartons, hygienic tissues, building papers, rayon fabrics, automobile tires, photographic film, and a host of other useful items.

The contributions of the Technical Association of the Pulp and Paper Industry to the progress of the industry and the economics of the World over the past 40 years are difficult to assess. However, there is no phase in which it has not had an interest nor where it has not endeavored to extend the boundaries of technical knowledge. This review attests to its previous accomplishments and indicates more extensive services to the industry in the future.

41st Annual Meeting
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Mount Hope FREE WHEELING EXPANDERS

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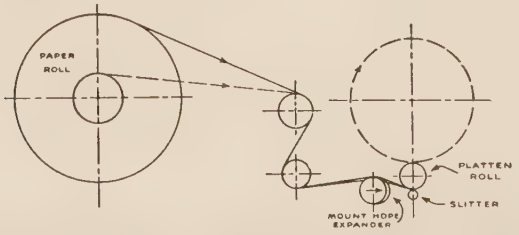
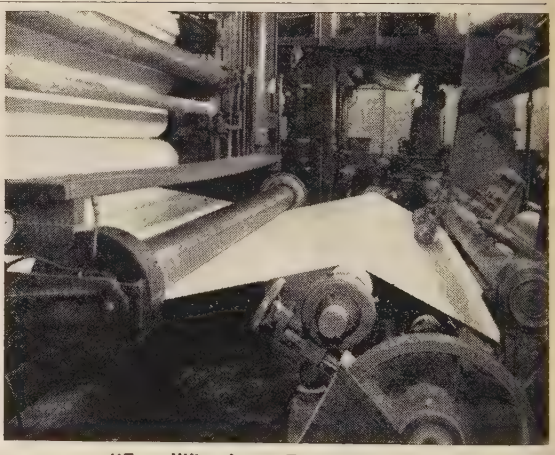


INSTALLATION ON SLITTER REWIND



"Free Wheeling" Expander ahead of Slitter and Windup

Mount Hope Free Wheeling Expanders completely eliminate wrinkles and baggy edges that cause out-of-register printing. Equally effective on all types of machines, on wet or dry paper. Save time and money throughout your plant!

Have a Mount Hope Engineer study your problems—or send for Free Bulletin EPC.

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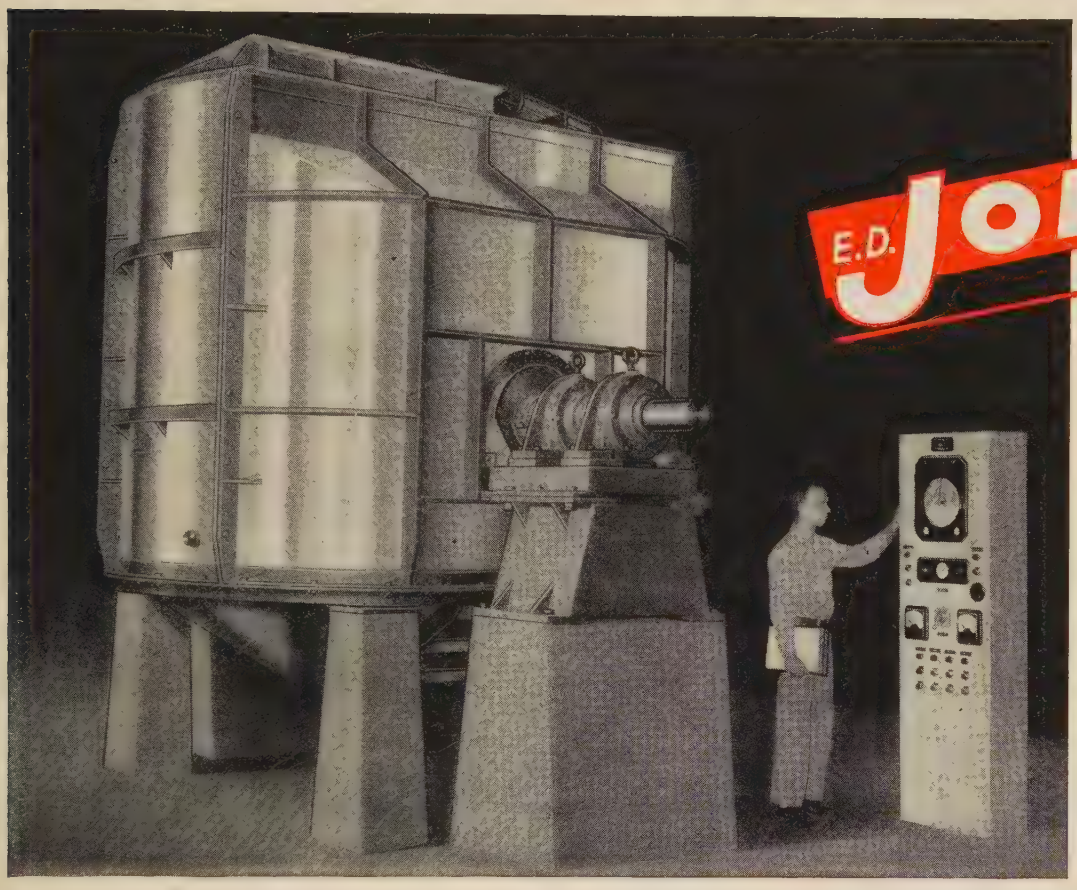

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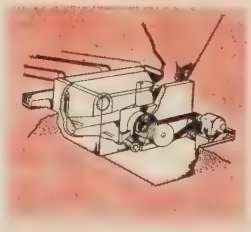
HI-LO PULPER

The unique feature of this new Jones HI-LO Pulper — individual rotors for circulating and defibering — produces complete defibering, without cutting, in minimum time and with most economical application of power . . . results impossible to achieve with a single-rotor pulper.

HI-LO Pulpers already in mill operation have produced results like those mentioned above. Ask your Jones representative for details or write us direct for Bulletin No. EDJ-1063.



BROKEMASTER: a further development of the HI-LO principle, introduces Hi-Speed and Lo-Speed Rotors in a custom-built under-the-machine set-up for pulping broke, with completely automatic controls, requiring no operating manpower.

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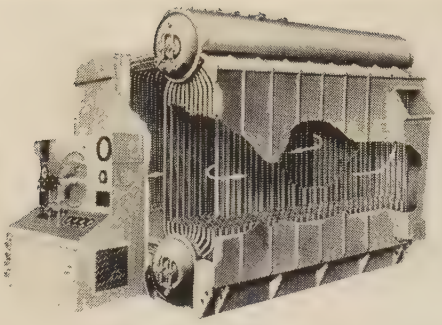
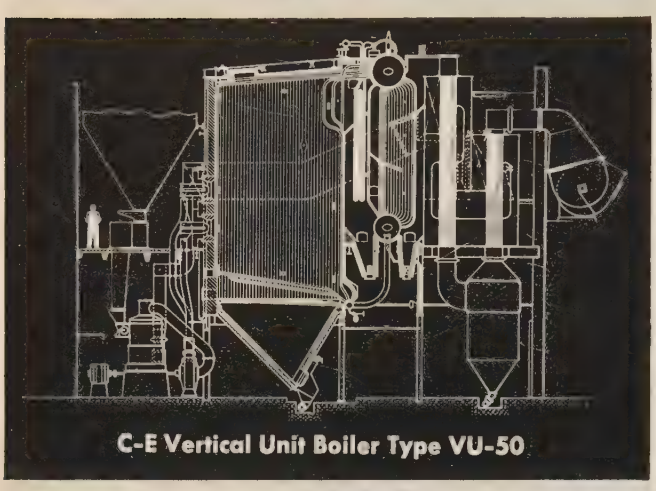
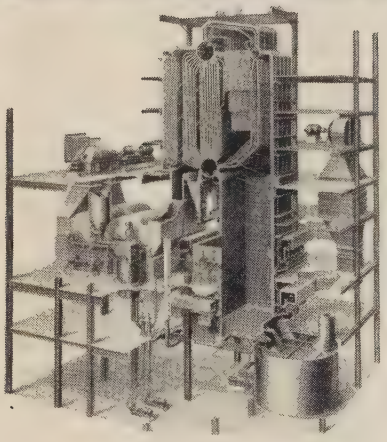


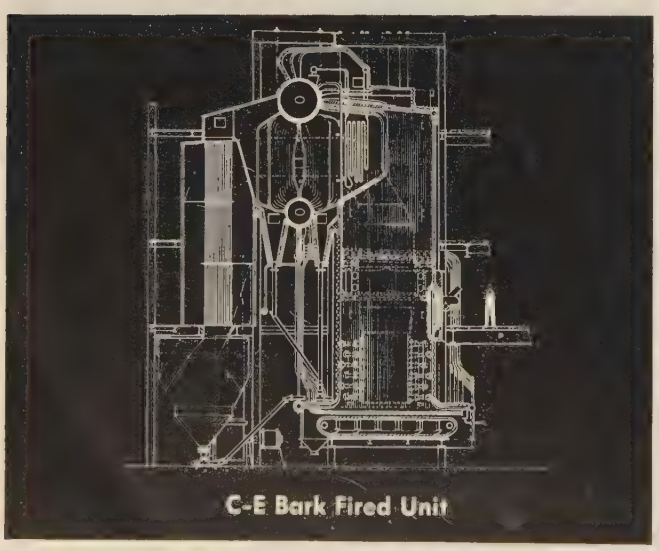
C-E Package Boiler



C-E Vertical Unit Boiler Type VU-50



C-E Recovery Unit



C-E Bark Fired Unit

Got a Steam or Fuel Burning Problem?... *See C-E!*

Package boiler, power boiler or chemical recovery unit—if your problem concerns how best to burn fuel to generate steam efficiently, reliably and economically—See C-E.

Why? Because C-E has a complete line of steam generating and fuel burning equipment both standardized and custom-made to fit all the specialized requirements of the pulp and paper industry. No matter whether you burn Black Liquor, Waste Sulfite Liquor, Bark, Hogged Wood, Coal, Oil or Gas, C-E offers you equipment *designed specifically* for each job.

The acceptance accorded C-E equipment by the Pulp and Paper Industry is evidenced by the following facts.

1. Since 1945, leading pulp and paper mills have purchased C-E power boilers having an aggregate capacity of more than 11,000,000 lb of steam per hour.

2. Since 1945, thirteen leading mills have reordered C-E power boilers. In fact, one internationally known paper company placed *seven separate orders.*

3. Since 1945, more than 80 C-E Chemical Recovery Units have been purchased by pulp mills throughout the world. These include units ranging in capacity from less than 100 tons to the world's largest, having a capacity in excess of 500 tons.

4. Since 1945, eighteen leading pulp mills have *reordered* C-E Recovery Units; of this number four mills have reordered twice and one mill three times.

5. The C-E Bark Burning System, the recent C-E development that has revolutionized bark and hogged wood burning, has already been installed in a score of pulp mills at home and abroad. Performance records show greatly increased efficiency and substantial savings over old fashioned bark burning methods.

These are but five indications of the widespread acceptance of C-E equipment in the pulp and paper industry. They are five good reasons why, before you buy, you should See C-E.

B-850

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THE OPTICAL WHITENING AGENT

BLANCOPHOR® HS-76 and BLANCOPHOR HS-71 are highly soluble fluorescent brighteners which produce unusually brilliant whites on paper, without risk of pulp degradation caused by overbleaching with strong chemicals. These optical whitening agents can be either added to the beater or used in surface coloring and coatings to give extremely high whites.

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the birth of a FOREST

Forests that supply raw material for Weyerhaeuser Timber Company's pulp operations require from 50 to 100 years to mature from seedlings. To protect our forests is to help build our nation. Without timber lands, America could not have undergone the greatest industrial development in the history of the world.

Emergence into a new forest economy has brought unprecedented progress in protection and overall management of timberlands. Weyerhaeuser's practice of providing for *natural reforestation* plus planting and seeding old burns is achieving continuous forest reproduction. This reforestation is accomplished with seed supplied from blocks of trees reserved during logging and left standing to re-seed the adjacent harvested area and from seedlings grown in the industry's forest nursery. Thus, this re-birth of a forest *now* assures a sufficient timber crop for *future* generations.

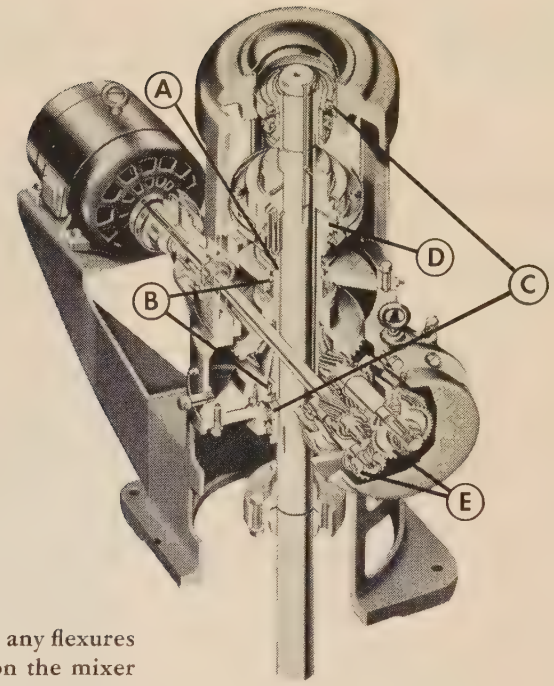
Through intensified forestry practices and research, Weyerhaeuser has achieved a sustained yield of pulpwood. Weyerhaeuser Timber Company can thus provide a constant supply of woodpulp for the paper and allied industries, both *now* and in the *future*.

WEYERHAEUSER

Why you'll probably get

20 years' service

out of this fluid mixer



No, we can't guarantee that LIGHTNIN Mixers will mix fluids, day in, day out, for 20 years or more. But a great many of them do.

Here are just a few of the reasons why *you* may find that LIGHTNINS in your tanks enable you to hold depreciation costs down where they belong —and keep productivity *up* by minimizing shutdowns for maintenance and repair.

An important part of this LIGHTNIN Mixer is the gearing. And that's the part that needs most protection.

The gears you see here are mechanically insulated from any flexures or sudden shock loads on the mixer shaft. The gears drive a hollow quill (A), suspended in heavy-duty bearings (B) which carry power transmission loads only.

The mixer shaft is suspended in its own separate pair of adapter-type prelubricated bearings (C). The shaft passes through the quill with full clearance. Shaft and quill are connected at only one point (D) by a flexible coupling.

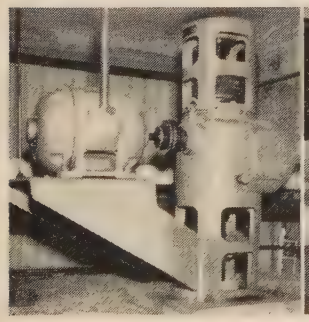
This hollow-quill construction isolates the shaft from the gearing. It saves wear on the gears, and protects them against damage. And it lets you remove the mixer shaft upward or downward, and you can even use shafts of different diameters.

Interchangeable speeds

The change gears (E) permit quick change of speed for a range of 16 standard AGMA speeds. You can change mixing speed, should it ever become necessary, by replacing two change gears with a pair of a different ratio. No special tools are required, and the mixer need not be removed from the tank.

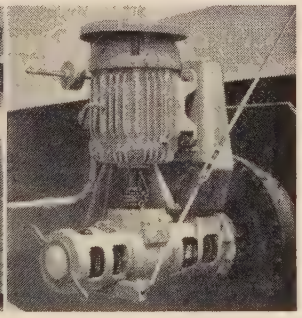
You can select from hundreds of power-speed combinations, in standard units, without need for special construction. Speeds other than standard can be had without limit.

Get set *now* to take advantage of the long-term savings you make with LIGHTNIN Mixers. For the full story, just call your LIGHTNIN representative, listed in Thomas' Register. Or write us today.



TOP ENTERING LIGHTNINs provide exact power-speed combination to fit the job. Models for open or closed tanks. Sizes 1 to 500 HP.

LIGHTNIN PORTABLE Mixers make any open tank an efficient mixing vessel. Thousands are in use. Electric and air driven types. Thirty models, ⅛ to 3 HP.



SIDE ENTERING units mix or blend fluids in tanks as large as 5 million gallons. Choice of stuffing boxes or rotary mechanical seals. 1 to 25 HP.

"Lightnin® Mixers"

MIXCO fluid mixing specialists

Get these helpful facts on mixing: cost-cutting ideas on mixer selection; best type of vessel; installation and operating hints; full description of LIGHTNIN Mixers. Free—no obligation. Just check data you want, tear out and mail to us today with your name and company address.

- ☐ B-102 Top Entering Mixers (turbine, paddle and propeller types)
- ☐ B-103 Top Entering Mixers (propeller types)
- ☐ B-104 Side Entering Mixers
- ☐ B-107 Mixing Data Sheet
- ☐ B-108 Portable Mixers (electric and air driven)
- ☐ B-109 Condensed Catalog (complete line)
- ☐ B-111 LIGHTNIN Rotary Mechanical Seals
- ☐ B-112 Laboratory Mixers

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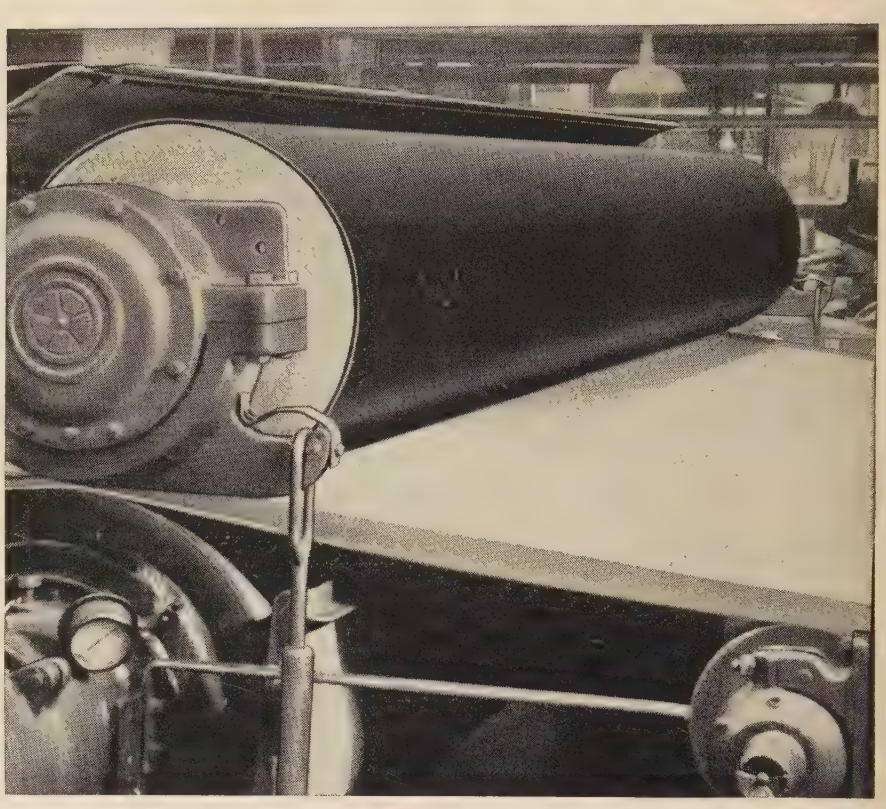

Look for a company that has developed a superior rubber to metal bond . . . a company with the experience and facilities to custom-compound roll covering to your specific requirements.

Cracking, hardening, corrugation, or separation of the rubber from the metal roll core are frequent sources of trouble with ordinary rubber covered rolls . . . resulting in costly losses in production, quality and schedules. Rubber covering for your rolls should be compounded to prevent these causes of machine downtime in your *particular* operations. The rubber should also be permanently bonded to the metal to prevent cover separation that ultimately leads to roll failure. Make certain the company that covers your rolls has the ability to produce the correct rubber compound for your needs . . . the equipment to vulcanize and grind your roll covering to your specifications . . . the facilities to handle your job regardless of size.

Specify rubber covered rolls custom-made by experienced roll covering specialists . . . specify Manhattan Rubber Covered Rolls.

MANHATTAN RUBBER COVERED ROLLS

Manhattan roll covering specialists have eliminated the major causes of expensive machine downtime to give you "More Use per Dollar" with Manhattan Rubber Covered Rolls. An exclusive Manhattan process provides an inseparable bond of rubber to metal to eliminate separation of the rubber cover from the metal roll core. Manhattan Rubber Covered Rolls are compounded to give you high-speed, uniform production under all working conditions . . . they won't harden, crack, corrugate or oxidize.

Custom-made to meet your specific working requirements, they assure permanent, uniform and correct density. Manhattan's modern precision roll grinding and vulcanizing facilities enable experienced craftsmen to handle the largest rolls in use today . . . and insure accuracy of dimension within .002". Call an R/M roll covering specialist to discuss your requirements. He will show you how you can get long, trouble-free service—"More Use per Dollar"—with Manhattan Rubber Covered Rolls. RM 519

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MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

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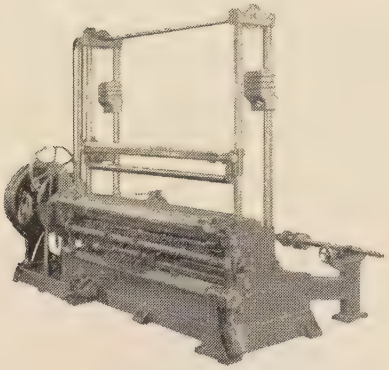
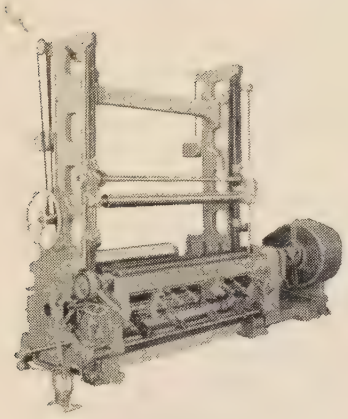
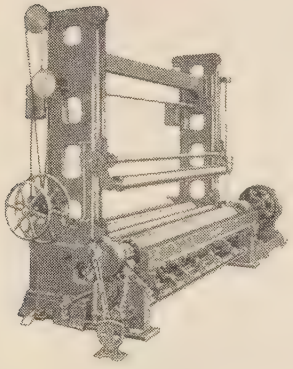
LANGSTON SLITTERS & WINDERS



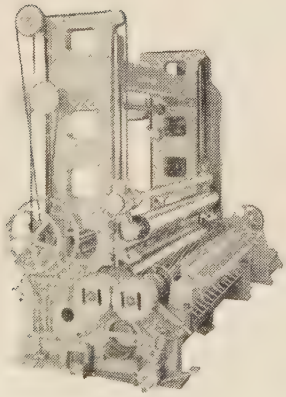
MODEL AA



MODEL BA

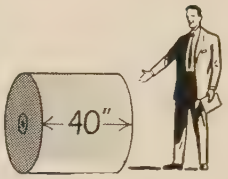


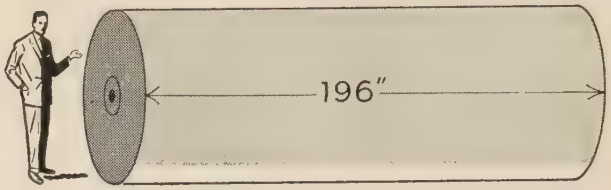
MODEL CA



MODEL DA

Available in sizes this narrow

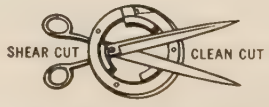




to this wide

The famous Langston shear-cut slitters cut all weights and grades of paper and paperboard—sharpening themselves as they run. They cut like scissors instead of a knife. Clean-cutting, they keep dust to a minimum. Assure square edges on sheet, clean rolls, and a clean plant. Shear-cut slitters are standard equipment on Langston Slitters & Winders without special order or extra charge. Various types of drive are available, depending upon the desired operating speed and the materials to be handled. Write for specific information on the size machine you need. SAMUEL M. LANGSTON CO., CAMDEN 4, N. J.

SPECIFICATIONS	MODEL AA	MODEL BA	MODEL CA	MODEL DA
Widths	40, 50, 60 and 72″	62, 72, 82 and 92″	82, 92, 102, 112 and 122″	82 to 196″
Speeds to	1500 fpm	1750 fpm	3000 fpm	4000 fpm
Max roll dia	28, 36 or 42″	40, 50 or 60″	40, 50, 60 or 72″	40, 50, 60 or 72″
Min cut	¾″	1 9/16″ stand 1⅜″ spec	2⅛″ stand 1½″ spec	3″ stand 1½″ spec
Winding drums dia	8 7/16″	9½″	11″	14 and 18″
Idlers dia	3⅜ or 6¼″	6⅜ or 9 7/16″	8½ or 10¼″	8½, 10¼ or 12½″
Cutter shaft dia	3″	4⅝″	5½″	7¼ and 8¼″
Pressure roll dia	3 or 4½″	5⅜ or 6⅞″	7½ or 9⅜″	8⅜ or 10⅜″
Weight	9000 lb (50″ mach)	17,000 lb (72″ mach)	23,000 lb (102″ mach)	36,000 lb (122″ st)



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The Engineering Situation—Locally and Nationally

A. D. BRUCE

The rapid advancement being made in the field of engineering is constantly increasing the responsibility of our universities and colleges of today. Engineering progress is setting a pace that leaves some of us almost breathless. The automobile you drove to this luncheon today probably has in excess of a 200-hp. motor. Twenty-five years ago you were probably bragging about a car that had a 50-hp. engine. This typical American phenomenon has been brought about by the work of engineers in many different fields.

Everywhere we turn we see and learn of other amazing advancements being made. We have witnessed in recent years a great acceleration in research, design, and production in the fields of electronics, atomic energy, jet transportation, and chemistry.

The engineering feats of tomorrow are already in the minds and on the drawing boards of today's engineers. Industry is spending millions of dollars each year in behalf of research and technological changes.

Yet we have not enough engineers. Lack of interest in mathematics and the natural sciences in high school, erroneous reports not long ago that the engineering field was being flooded, and increasing demands for engineers are just some of the reasons for the shortage.

Because engineers and scientists hold the key to progress in this swift-moving technological age, the shortage is creating an increasingly serious problem. In 1955 there were only three engineering graduates from institutions in the United States for every five new engineers needed by industry for that year. In actual numbers, according to estimates of the Engineering Manpower Commission of the Engineers Joint Council, this meant that industry has jobs for some 37,000 engineers; our colleges graduated only 21,500.

Assistant Defense Secretary Donald Quarles has termed the shortage as "potentially a greater threat to national security than any aggressor weapons known." Not only must our nation keep pace with normal growth, it must also consider the new production burdens created by the "cold war" in which we are engaged.

The engineer supply is not only falling behind American's needs. It is also failing the United States in the military-technological race with the Soviet Union. For instance, the Russians stepped up graduations until last year 53,000 engineers were turned out—a rate two and one-half times greater than that of our nation.

However, because of the emphasis being placed on engineering as a field of study, headway is being made in filling the gap of numbers. We know that in 1953 there was a tremendous increase in entering freshmen who plan to study engineering. This increase will be reflected in 1957 and 1958 graduating classes, and will probably continue.

But the real, present-day shortage is at the Ph.D. level and includes physicists and mathematicians as well as engineers. Because of the smaller classes which have graduated in the past few years, graduate enrollment has been severely hurt. Consequently, our colleges and universities are finding it increasingly more difficult to find qualified Ph.D.'s in the field of science and engineering.

Commenting on this subject recently, President James R. Killian, Jr., of M.I.T. observed that the engineering crisis is not a matter of numbers alone. "There are many areas of technology," he said, "that are now closed books to those engineers lacking creative powers or to those whose training or analytical abilities never carried them beyond the superficial methods of handbook engineering. Employers are not just looking for 'bodies' with degrees. They are pressing the colleges for men with a more fundamental, integrated education in science, engineering, and the humanities. They want men with the power to deal with the technologies of tomorrow and not of yesterday."

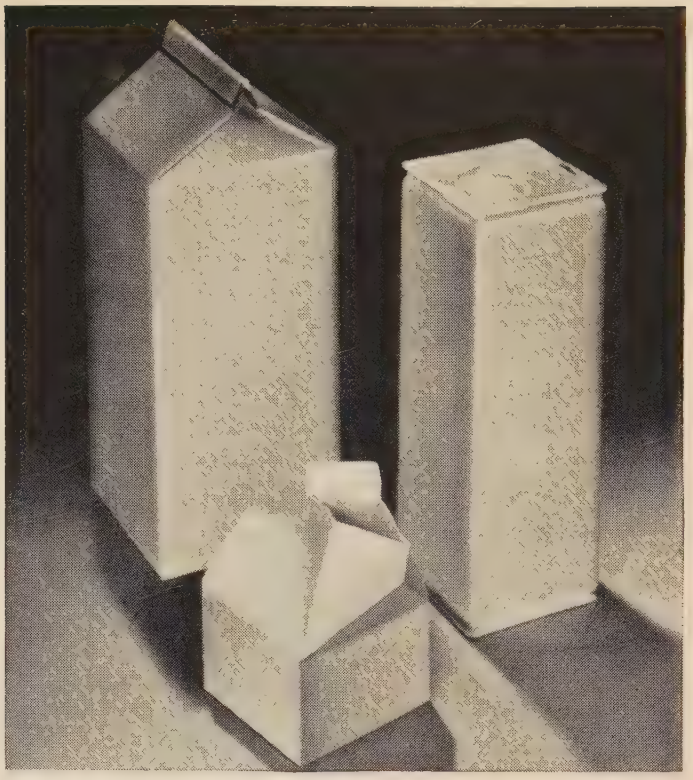
In studying facts and figures of regional enrollments, we find that the entire southern area including Texas is amazingly deficient both at the M.S. and Ph.D. level. As a Texan and president of a Texas institution of higher learning, I dislike admitting such a condition exists. Possibly, we can be awakened sufficiently to do something about it. A simple comparison between Texas and California will demonstrate what I am saying. Last year Texas graduated only 10 Ph.D.'s in engineering whereas California graduated 87 even though it had a smaller undergraduate enrollment. One out of 16 California engineering graduates took his Ph.D. while only one out of 100 Texas engineering graduates took his doctorate. Obviously, many southern boys are going elsewhere for advanced study. For the southern states as a whole, the number of M.S. degrees needs to be doubled to equal the national average. We can draw only an inescapable conclusion from figures such as these. The South and Texas are highly deficient in training advanced students.

Now, let us take up the subject of research. We know that research is an integral part of our American industrial system and that is it underway in many areas in great intensity. We know also, that somehow it must be increased and not permitted to diminish for lack of funds or talent.

Although our nation's industry is spending in excess of 4 billion dollars a year on research, this expenditure represents only a little more than 1% of our gross national product. This is pitifully small when one considers that a major part of the growth of our national production in the past 50 years has been the direct results of research. The situation becomes still more

Lt. Gen. A. D. Bruce, Ret., President of the University of Houston, at Houston, Texas.

THE RIGHT GRADE FOR ANY SIZING JOB



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grotesque when we consider that less than 10% of the research expenditures are devoted to fundamental research.

A nation and a people cannot long ignore basic and pure research, as we surely have done, and expect to keep up with the advances being made in other parts of the world. The physical world is too much with us for us to hide "our heads in the sand" and go blithely along out-producing the rest of the world and at the same time lagging behind in the type of research which will be responsible for the technological progress made 100 years from now.

Just recently, Homer L. Dodge, president emeritus of Norwich University in Vermont, returned from a visit to Russia where he studied first hand the Soviet educational system. Mr. Dodge states that the Russians, today, have a better appreciation of the value of pure research than our nation does. "The best science students," he says, "go into research or continue their academic work."

I hope I do not appear pessimistic about the over-all picture I have reviewed today, but we must be realistic. Most of you here today are already aware of the shortage of engineers in numbers, the shortage of engineers who are pursuing advanced studies, and our woeful shortcomings in the field of research. But I feel that it is up to all of us to carry this message to the public and to the foundations and to the individuals with the financial resources who can help the one group that is interested and able to do something about these matters. I am speaking of our institutions of higher learning. It is up to our institutions of higher learning to train the engineers—in numbers and in quality—to meet the shortage, to offer the courses for advanced study and the facilities for basic research. This, of course, places a greater responsibility on our colleges and universities. But it also provides them with a great challenge, which they are happy to meet providing they are given the assistance required to do the job.

I have been aware of the problem as it affects the nation and the Texas area for a number of years, even before becoming president of the University of Houston.

A few years ago, as deputy commander of the Fourth Army, I visited just about every town in Texas, large enough to have organized reserve or National Guard units or recruiting stations. As one especially interested in the strategic aspects of industry and plant security, I had occasion to visit many industries. As an umpire of a series training command post of exercises in the southwest, I reconnoitered the inland waterways from Brownsville to Lake Charles on several occasions and made hundreds of air flights over this general area. I received an over-all view and impression of the immensity of this rapidly growing Texas industrial area. I realized then the problems such expansion would create.

Now, what is the University of Houston doing to meet these problems? It is our belief that we are developing an educational program that will answer many of the problems and the growing needs of the enlarging field of engineering. We got off to a good start last spring when we obtained the services of Frank Tiller as our new dean of the College of Engineering. Former dean of engineering and director of the Research Center at Lamar State College of Technology at Beaumont, Dr. Tiller came to us as one of the two foremost mathematicians and scientists who have graduated from the University of Louisville in the past 25 years. His many articles and publications and participation in research programs for some 10 industrial and chemical firms belie his age of 38. Already we at the University detect the improvements he has helped bring about with the assistance of a very capable staff. Dr. Tiller, a chemical engineer, is giving us leadership in a field that will reflect credit on our institution and this community. We are strengthening our faculty and will continue to do so. In our College of Engineering we are focusing our attention on six departments—civil, electrical, industrial, mechanical, petroleum, and chemical. We are in the process of revising our engineering curriculum in which we will place greater emphasis on the fundamentals. It is our intention to eliminate any courses which do not serve the ends of a good engineering program. At the same time we will add courses when they are needed.

By means of our university counseling program, we are taking cognizance of those students who have received sound training in high school and are placing them at an advanced level in mathematics. In this manner, we hope to encourage the high schools to do a good job of teaching by carefully recognizing those who have done a good job of teaching. We want to encourage only those students who are qualified to enter the field of engineering. We all recognize that every student does not have the aptitude, or the ability for engineering.

To bridge the gap that has too often separated high schools from universities and colleges, we plan to inaugurate next spring a plan whereby high school science and math teachers will be invited to our campus to attend short seminars to learn from outstanding men in the field what is taking place. This information will then be passed on to high school students. We feel that by developing a closer relationship with high school teachers, we will avoid many of the pitfalls that have hurt us both in the past. There is no reason why the science and math courses on a high school level cannot be closely integrated with the university and college program. And we are willing to do our part to bring about a closer relationship.

In the field of research, I feel the University of Houston is also making some headway. While research has always had a place in the academic program of our institution, it became formalized with the establishment of a research institute back in 1951. At that time various programs then underway, or planned were organized and coordinated under a single director.

Headed by H. J. Sawin, eminent scientist and dean of our graduate school, our research institute has moved along quite well. The institute was set up primarily to foster both pure and applied research by our university staff. In its operation, every effort is made to evaluate research projects, to place the projects in their proper area, and to obtain the funds necessary to their implementation.

I hope I have given you some idea as to what the University of Houston is doing to help solve some of the problems facing us in the field of engineering. It is our desire to please you as potential, or present employers

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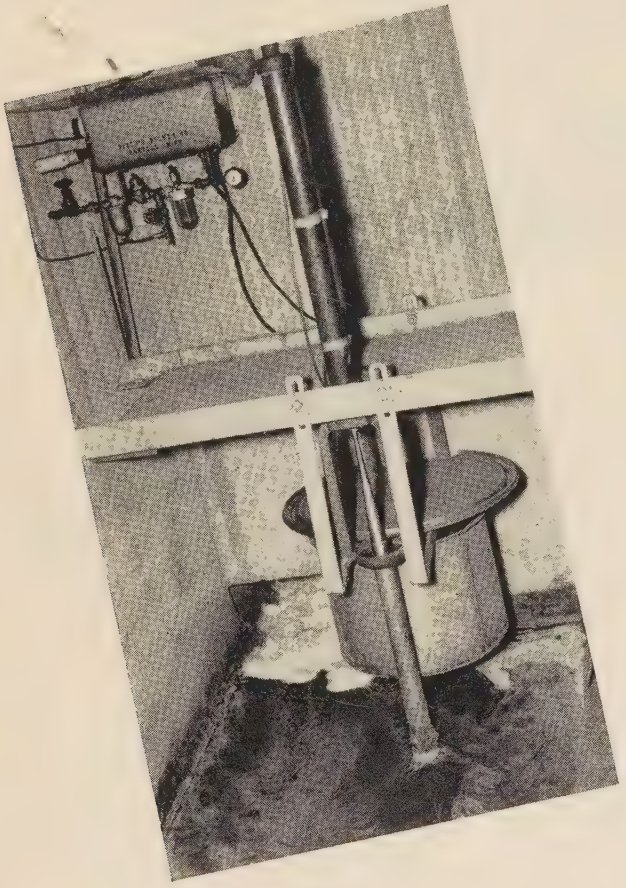

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of graduates from the University of Houston's College of Engineering by providing a first-rate product of whom we can both be proud. But foremost, we are striving to establish an institution which will provide the student with the best education possible. That is the reason for our existence. If we succeed in this objective, and we will, we will all benefit. We will have a College of Engineering of which we can all be proud. We will graduate students who will reflect credit on themselves, their institution, and their place of employment. Success will mean that society will benefit and our nation will grow to untold heights.

In closing, I might say your group can help us realize this objective. We need your encouragement and support not only to furnish you, of industry, competent personnel, but to do our part in national security—yea, national survival.

We need engineers.

PRESENTED at the Tenth Engineering Conference of the Technical Association of the Pulp and Paper Industry, Houston, Texas, Nov. 7–9, 1955.

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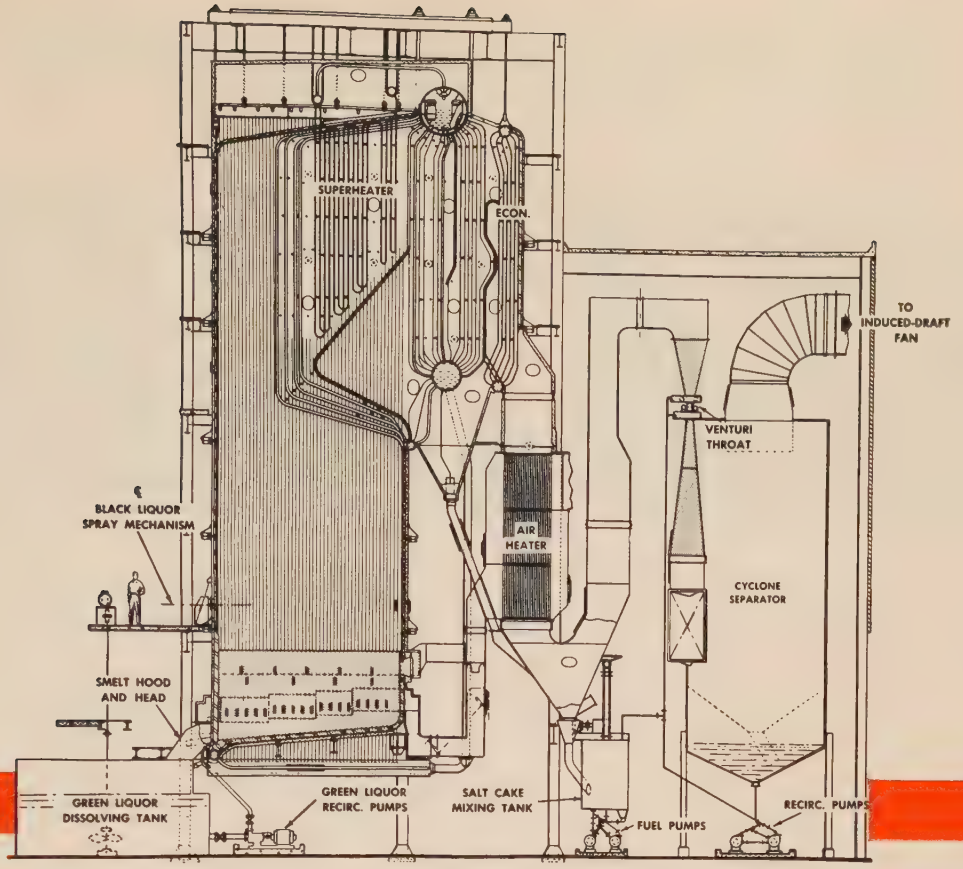

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The Venturi Evaporator-Scrubber is an important addition to B&W's equipment for black-liquor recovery. B&W can select exactly the right combination for your mill, as in the case of Thilmany Pulp and Paper Company.

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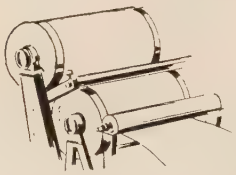

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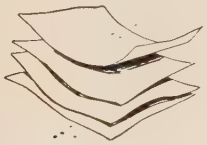
Our Eagle Brand Pearl Corn Starch is a popular starch for surface size. It is a thin-boiling starch of high fluidity. It is recommended for its desirable surface film-forming qualities and its uniformity.



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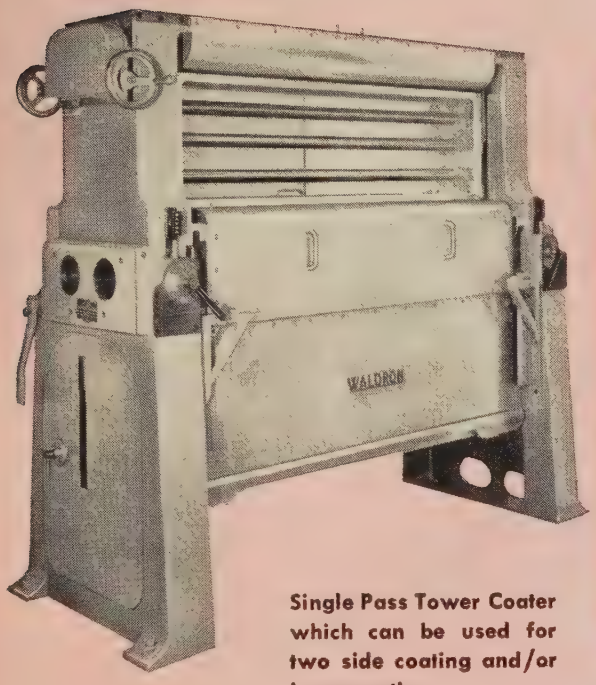
For Unequalled Experience in Modern Machine Building



Single Pass Tower Coater which can be used for two side coating and/or impregnation.

Specify WALDRON

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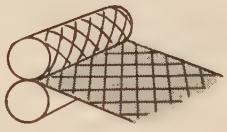

LAMINATORS

Foil
Film
Paper
Cloth

WEB HANDLING EQUIPMENT

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Slitters
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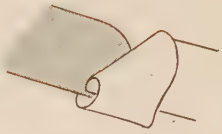

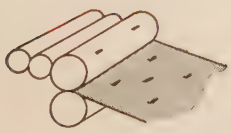

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JOHN WALDRON CORP.

Leaders In Web Process Engineering Since 1827

NEW BRUNSWICK NEW JERSEY

High-Brightness DICALITE Lets you S-T-R-E-T-C-H Pigment and Fibers

It's the continuing experience of many paper mills that both fibers and pigment "go farther" when high-brightness Dicalite paperaids are added to the furnish. Because Dicalite paperaids have the highest brightness of any natural diatomite applicable for papermaking (average brightness 74 or better on the G.E. scale) they extend the value of more expensive pigments such as TiO_2. Because of the unique diatom structure of Dicalite paperaids, they help to prevent "clumping" of the fibers, thus leading to a smoother, more uniform sheet. Taken together, these properties of Dicalite paperaids help to make a whiter, brighter, more opaque sheet of paper . . . with a saving of fiber and pigment! And, in addition, you get all the other advantages of Dicalite paperaids—less pitch, wax or asphalt troubles, better drainage on the wires, faster drying, increased machine speeds.

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Dicalite BP-5 is packed in bleached white sulphate bags, with a minimum of printing in water-soluble ink. Just slash the bag two or three times and throw the whole thing in the beater—saves time, trouble, mess and clean up.

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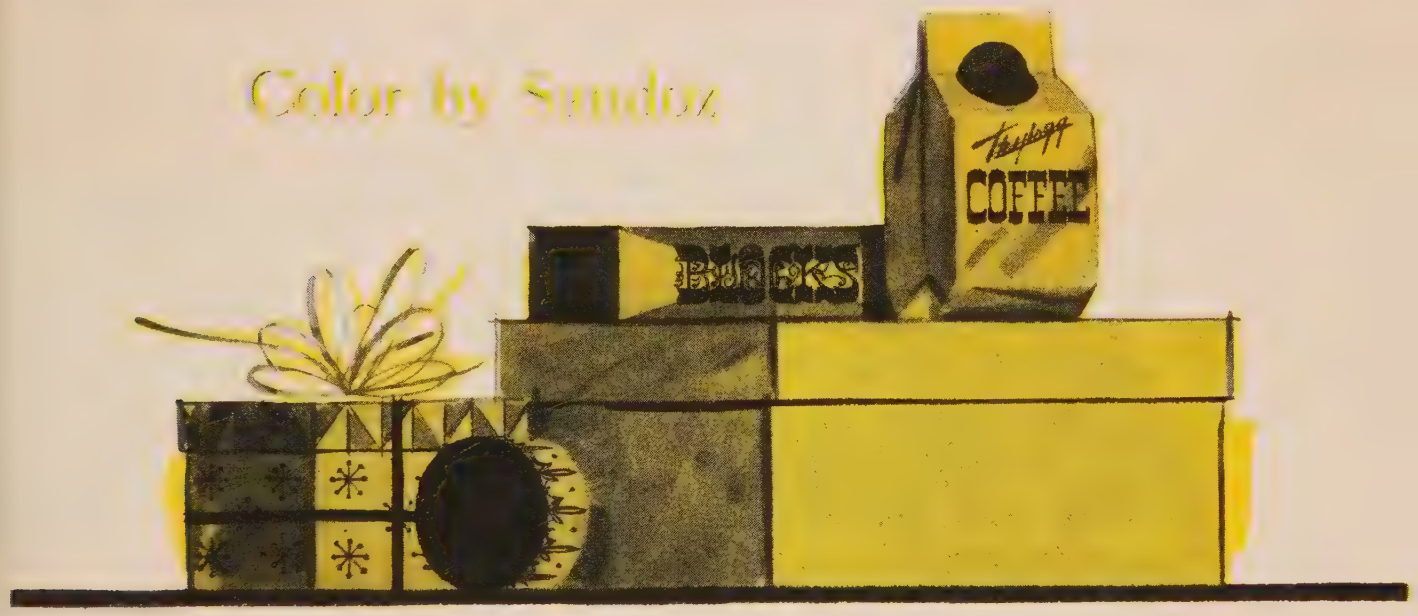
Paper by preference...

Color by Sandoz



New products, new uses, new customers every week of the year! Paper with color-appeal is building tremendous new markets—new profit opportunities.

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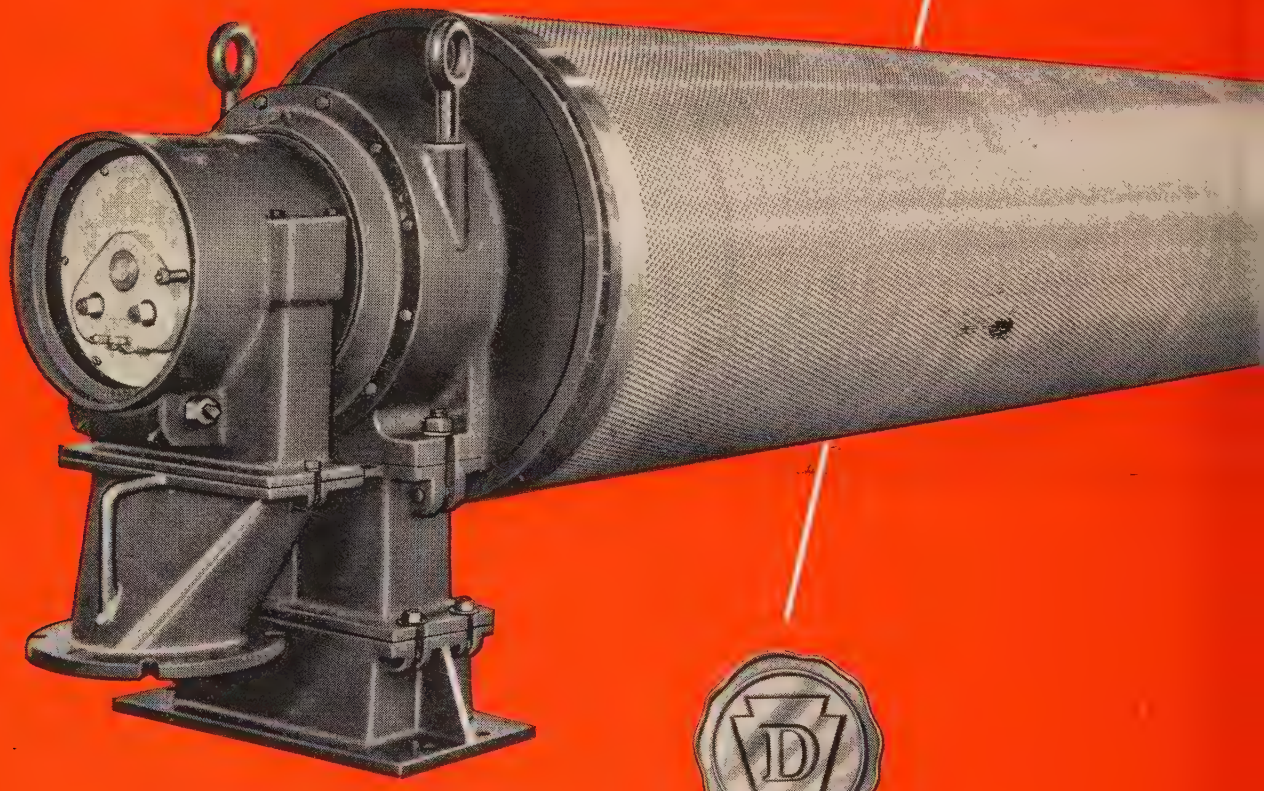

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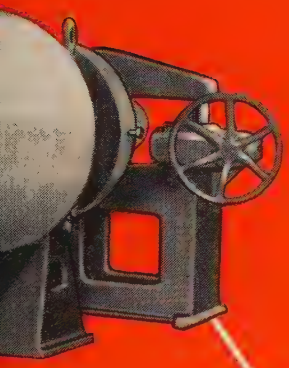
Proudly Presents...

to the Pulp and Paper Industry

a Complete Line of
SUCTION ROLL and VACUUM EQUIPMENT



As Downingtown Manufacturing Company terminates its paper machinery manufacturing activities, the Black-Clawson Company becomes the source of the famous line of Downingtown Suction Rolls. This equipment is now designed, engineered and built by experienced Downingtown personnel at Black-Clawson's Machine Division, Watertown, N. Y.

The joining of these two well-known names provides the pulp and paper industry with a single source for a most complete and modern line of Suction Roll and Vacuum equipment for every paper machine application.

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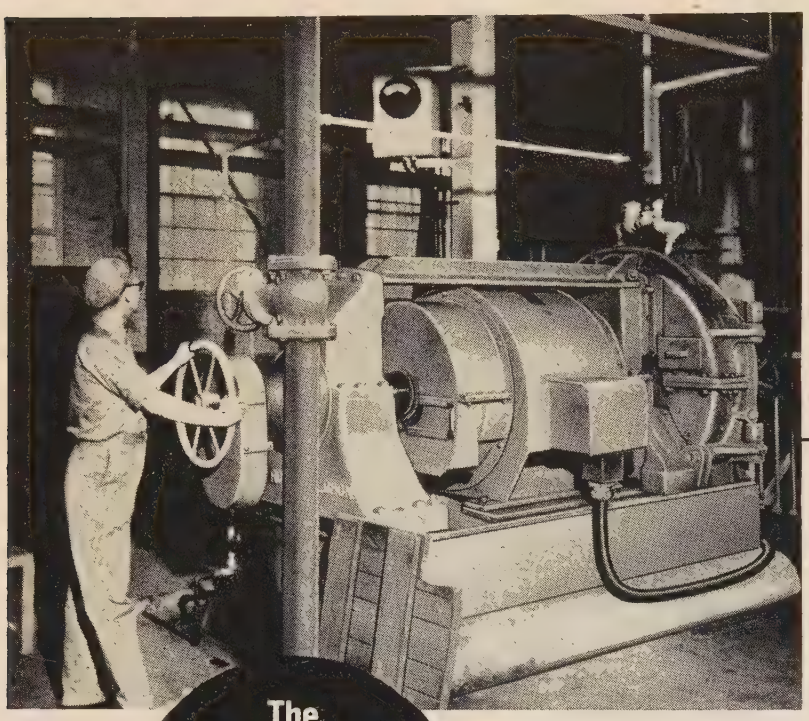
for economical semi-chemical pulping

RICHMOND PULP & PAPER CO. of CANADA, LTD.



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SPROUT-WALDRON 36-2 REFINER and FEEDING SYSTEM

Richmond—the first newsprint mill in Canada using hardwood neutral sulphite semi-chemical pulp—uses a 450 h.p. Sprout-Waldron 36-2 Refiner. Pulp is made from aspen and birch. The semi-chemical pulp refiner is fed by a Sprout-Waldron Uniflow Feeding System. Richmond also uses another 450 h.p. Sprout-Waldron 36-2 Refiner to refine groundwood rejects into a strong, fibrous pulp.

The SPROUT-WALDRON refiner is the leading producer of semi-chemical pulp

Single rotating disc design with peripheral control ring plus rugged construction for . . .

High Pulp Quality
Flexibility of Operation
High Capacity
Low Maintenance

For more information on semi-chemical pulping, or any other pulping application, send for our file of technical and practical data.

Write to Sprout, Waldron & Co., Inc., 38 Logan St., Muncy, Pa.

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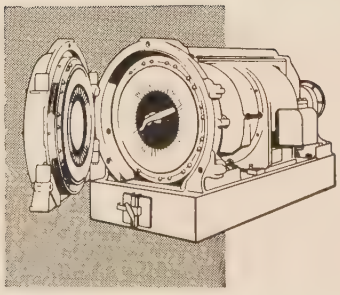

for your pulping problem—

SPROUT-WALDRON

PULP REFINERS

380

Mersize RM Dry delivers dependable hard sizing at Badger Paper Mills

Years of producing high-grade papers by Badger Paper Mills, Inc., Peshtigo, Wisconsin have created a genuine appreciation for a size that would deliver uniform hard sizing and trouble-free operation.

Technical Director John Hanson was among the first to test Mersize RM Dry when Monsanto introduced it to the paper industry last year . . . and it's been on the job ever since. With Mersize RM Dry, Badger was able to replace two other sizes and achieve smoother machine operation. "In fact," says Hanson, "we've improved sizing on all grades."

If you're a dry size user, see for yourself how Mersize RM Dry's dependable quality can increase the efficiency of your operation.

Beater-room men appreciate low-dusting Mersize RM Dry—less irritating, less trouble to handle. Its low foam characteristics help eliminate foam and improve formation.

Mersize RM Dry's light color and resistance to darkening with age, produces high-brightness paper comparable to the lightest rosin size.

For full information on Mersize RM Dry, write Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Box 478-G-7, St. Louis 1, Mo.

Mersize: Reg. U.S. Pat. Off.

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only the best. With the **EMERSON Stainles
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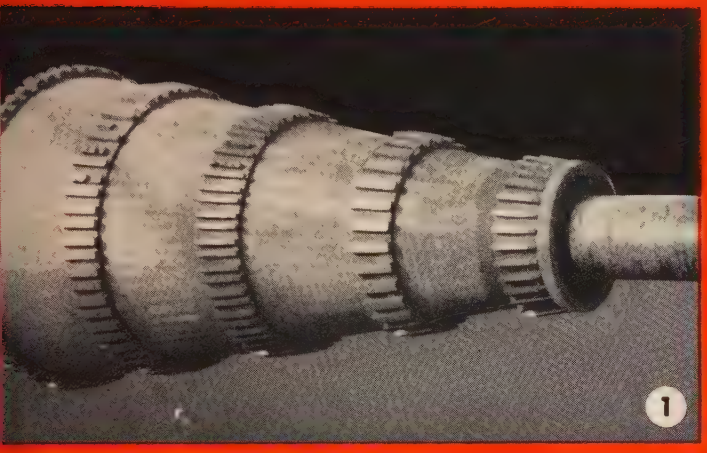
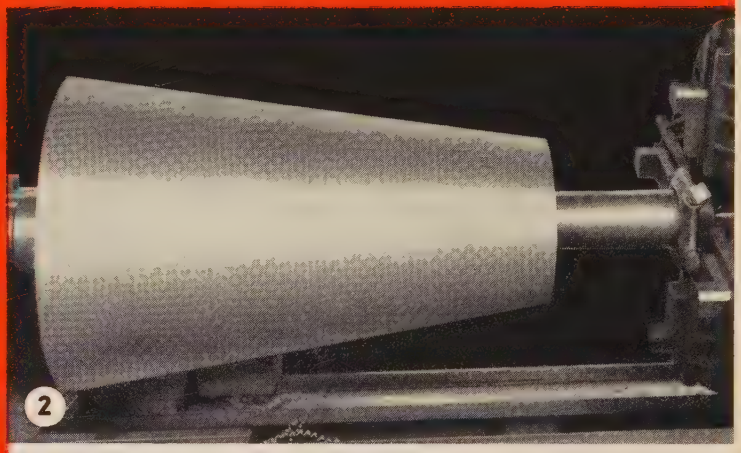
from The Papermaker

EMERSON, and only **EMERSON**, **patented Stainless Steel Jackets** are designed for **any** Jordan plug — are designed for **any** size, **interchangeable**, **BOLTON Wedgeless Plug Knives** to meet your production requirements. To have these advantages here's all you do:

Remove your old plug and shaft intact (don't spend a cent dis-assembling plug from shaft) and ship.



Typical worn, corroded plug during processing to restore its usefulness with a stainless jacket.



Mounted stainless jacket being precision machined prior to slotting.

Patented jacket construction for maximum strength and service. Knives of any metal or size can be interchanged.

Your old plug ❶ is turned down and a heavy stainless jacket is applied by a patented process. It is precision machined ❷ then milled to form dove-tailed wedgeless slots for the knives. New shaft sleeves, stainless steel end plates and stainless steel end rings are mounted. The plug is tested for perfect balance and the shaft indicated for straightness.

With woods and knives installed on the stainless jacket the transformation is complete. Your plug becomes a new solid unit of operating strength ❸ completely protected against corrosive liquids and equipped with performance-proven **BOLTON Wedgeless Fillings** for long, trouble-free, rugged service.

Want to learn more about **EMERSON Stainless Steel Jackets?** *Clip and send this coupon now!*

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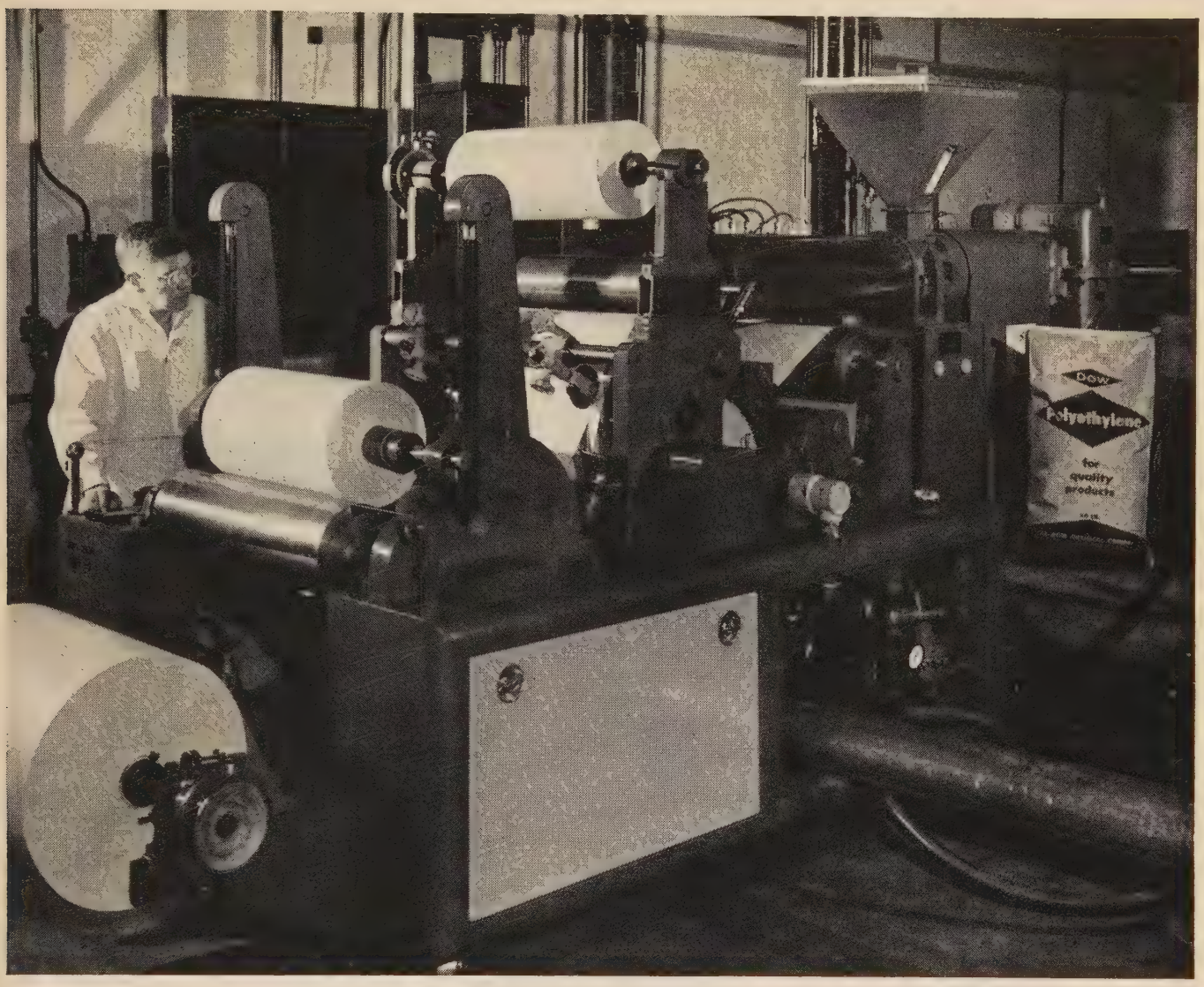

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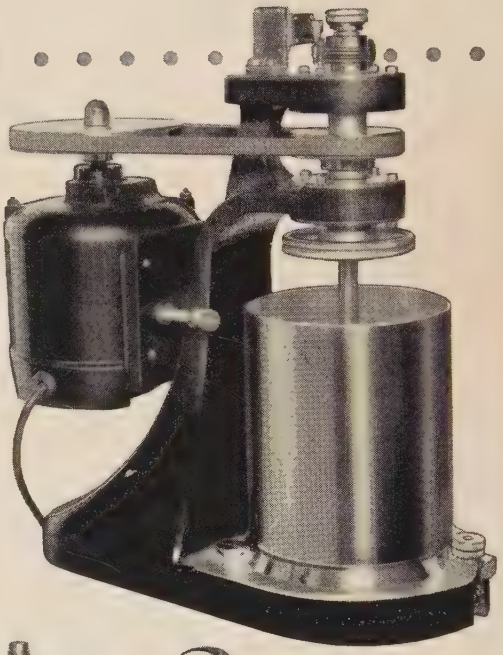
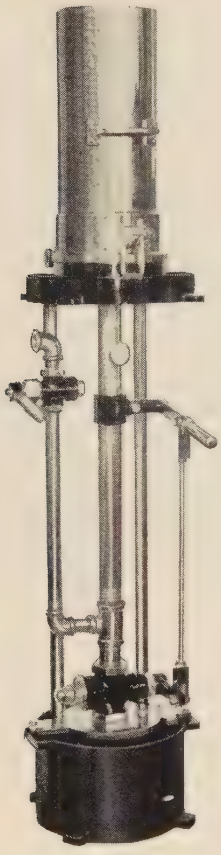
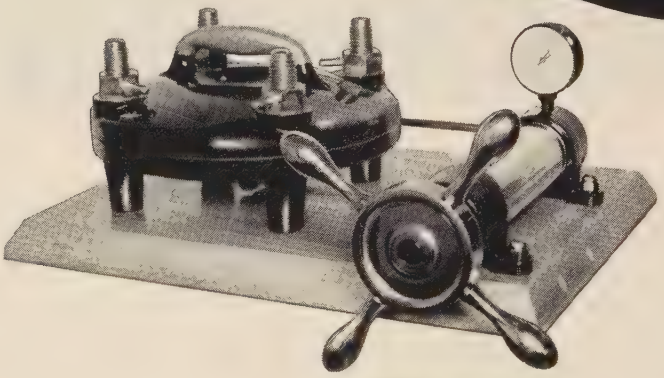
Pulp Testing and Sheet Making Apparatus



TAPPI Disintegrator



TAPPI Sheet Making Machine



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AUTOMATIC COUCHING AND PRESSING EQUIPMENT
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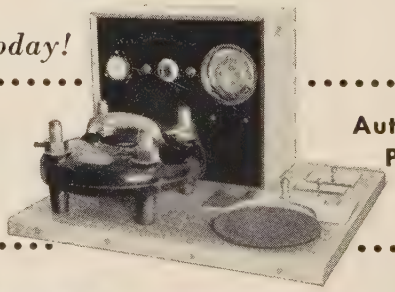
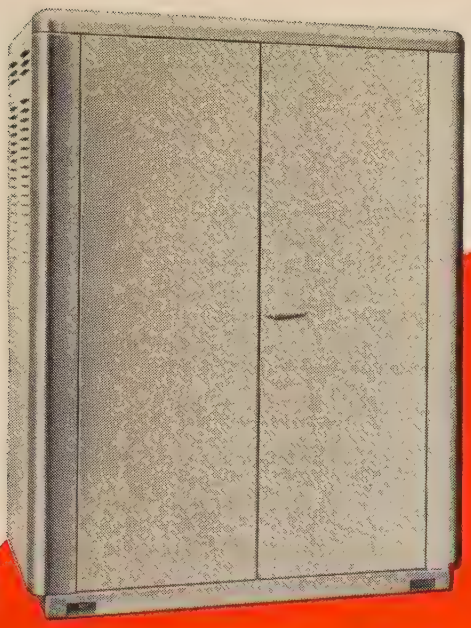


Automatic Press

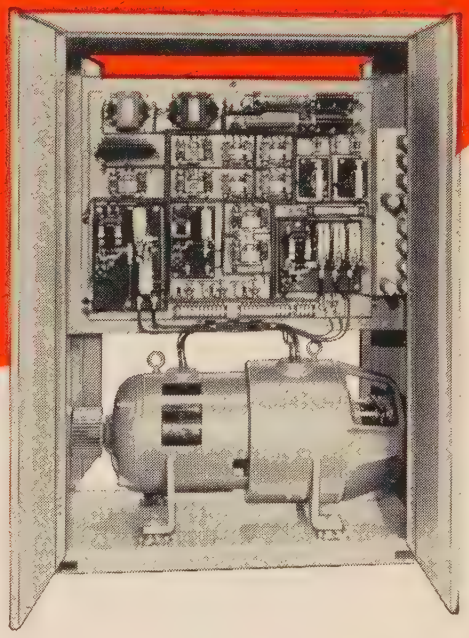
THE HERMANN MANUFACTURING CO.
LANCASTER, OHIO



This neat control cabinet houses the a-c to d-c power conversion unit, plus the control required for the particular application. The cabinet is pressurized to prevent entrance of dirt, dust, etc.

Providing d-c motor performance from a-c power supply...

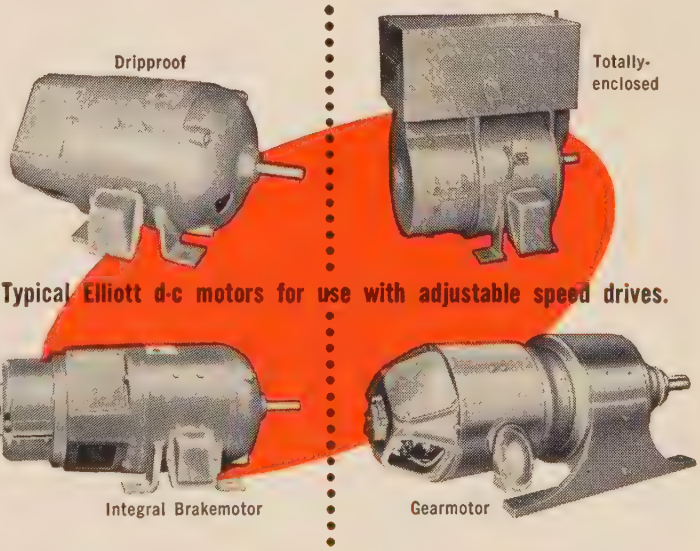
ELLIOTT C-W *Packaged* Adjustable-Speed Drives Type VV



A special 15-hp power package designed for voltage regulated multimotor drive. It provides complete control and supervision of drives from a remote operator's panel.

THESE PRE-ASSEMBLED, pre-wired power packages offer simple, convenient speed adjustment without intermediate speed changing or line-shafting. In addition to starting, speed adjustment and positive stopping controls, the units can easily be modified for special operations. To name a few: reversing, jogging, creep speeds, dynamic braking, preset speed, multimotor drive, etc.

Elliott adjustable-speed drives are designed for ratings to 200 hp—speed ranges to 16:1 and up for 208, 220, 440 or 550 volts — 25, 50 or 60 cycles, 2 or 3 phase. All power package components are backed by the Elliott Company's more than half-century of experience in the manufacture and application of industrial drives. For a simple and positive solution to any drive problem, call your local Elliott representative or write to Elliott Company, Crocker-Wheeler Division, Jeannette, Pa.



Typical Elliott d-c motors for use with adjustable speed drives.

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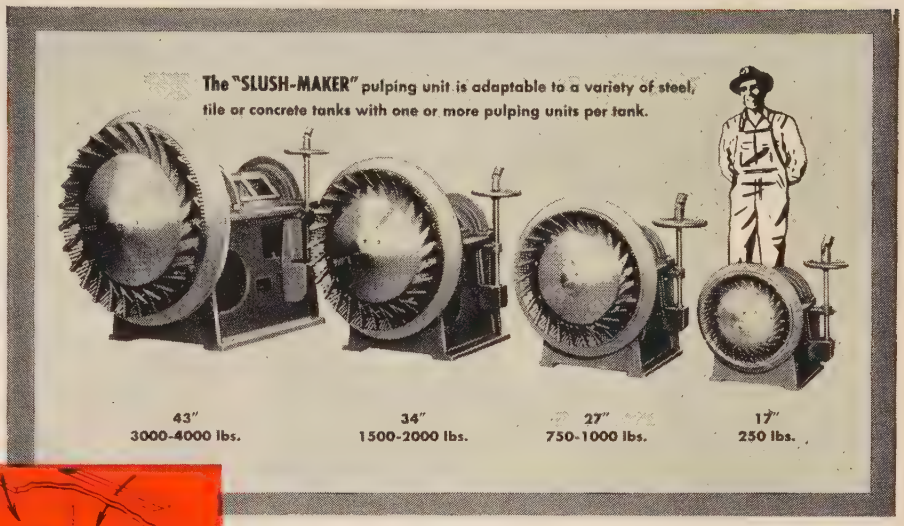
Patented

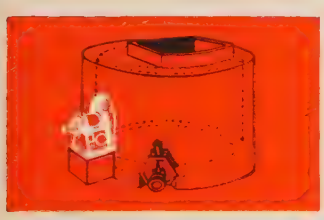
For Pulping

The Morden "Slush-Maker" can be used for either continuous or batch operation. Whichever method is used, there is a rapid defibering.



These thumbnail sketches show some of the many tanks that can be designed to suit specific mill requirements.

Dry-End Continuous Broke Pulper with Single Rotor

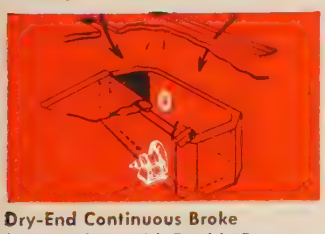


Low-Headroom—Side-Discharge Tank

Special Single-Wall Cylindrical Tile Tank

Standard Double-Rotor Tank for Larger Capacity

Special Cylindrical-Top Steel Tank



Dry-End Continuous Broke Paper Pulper with Double Rotor

Standard Tank with Special Charging Port

Advantages

- **Full Bales or Slabs** can be charged by hand, lift truck or conveyor.
- **Dry-End Broke** can be handled continuously, directly under the paper machine.
- **Wet-Strength Papers** are readily reclaimed with the "Slush-Maker".
- **Rapid Pulping Action** permits greater production per day.
- **Operation** can be batch or continuous.
- **Vigorous Circulation** thoroughly mixes the colors and chemicals in less than a minute.
- **Completely Cleared Stock** reduces amount of beating and jordaning treatment required after pulping.
- **Tramp Materials** will not damage or bind the pulping unit.
- **Side-Mounted Pulping Unit** permits low-headroom applications, simple drives.

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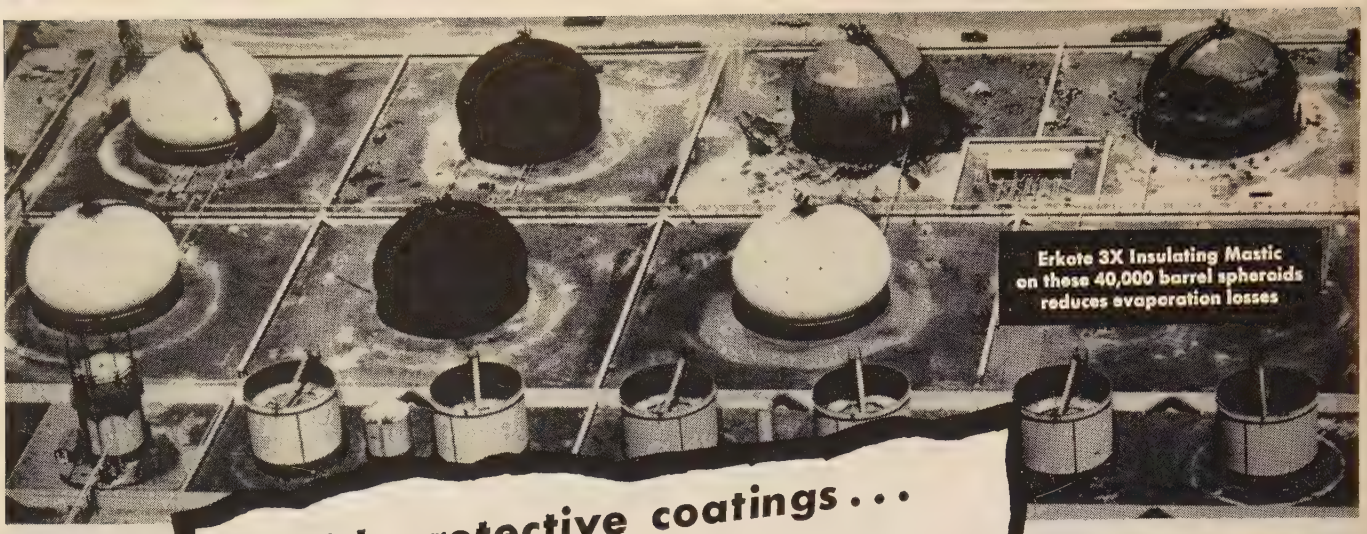


Erkote 3X Insulating Mastic on these 40,000 barrel spheroids reduces evaporation losses

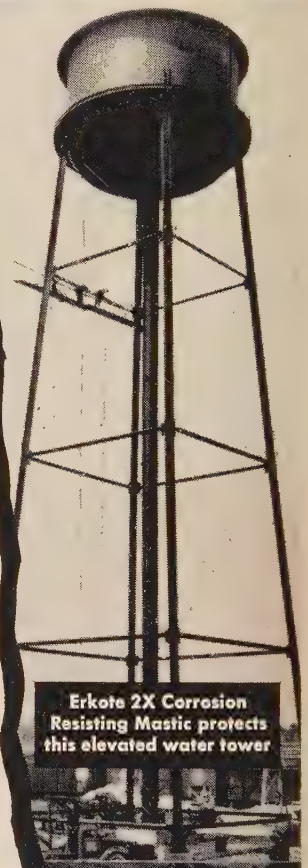
With protective coatings . . . on-the-job performance is what really counts!

ERKOTE® Mastics have a record of proven dependability

In refineries, in paper mills, in chemical plants . . . in every type of industry where surface protection is a problem . . . ERKOTE Insulating and Corrosion Resisting Mastics provide a permanent protective coating. They are bonded to the surface in one seamless application that offers unusual resistance to chemicals, corrosive fumes and extreme weather conditions. Even under severe thermal changes, ERKOTE Mastics remain flexible . . . never dry out or peel off!

In addition, we produce our own mastics and paints and furnish our own trained crews to apply and maintain ERKOTE products. One source—one responsibility—for materials and workmanship!

Erkote 4X Vaporseal protects thermal insulation on cracking columns



Erkote 2X Corrosion Resisting Mastic protects this elevated water tower

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FOR USE WHERE PAINTS FAIL

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EARL PAINT CORPORATION
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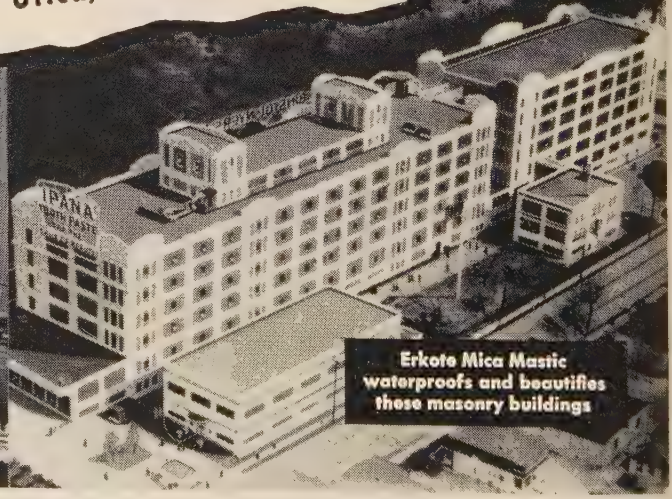
Erkote 3X insulates operating equipment — Erkote 2X rust-proofs steel supports



Erkote Mica Mastic waterproofs and beautifies these masonry buildings

Check PAPER POROSITY and SMOOTHNESS instantly

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In addition to an *instantaneous* check, the range and precision are considerably beyond what is specified in TAPPI Standards No. T-479 sm 48 for smoothness—No. 40-M49 for porosity. Many more checks can be made, assuring more uniform quality. And it doesn't take a highly skilled laboratory technician to get accurate results. Readings correlate with those of other instruments.

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- **Can be used in the mill or laboratory**
- **Gages are easily and quickly read**
- **Reading is visible until paper sample is removed**
- **Combines sensitivity and ruggedness**

Write for a demonstration in your plant and for engineering data to Div. 600, **THE SHEFFIELD CORPORATION, Dayton 1, Ohio, U.S.A.**

Porosimeter

Paper Smoothness Tester

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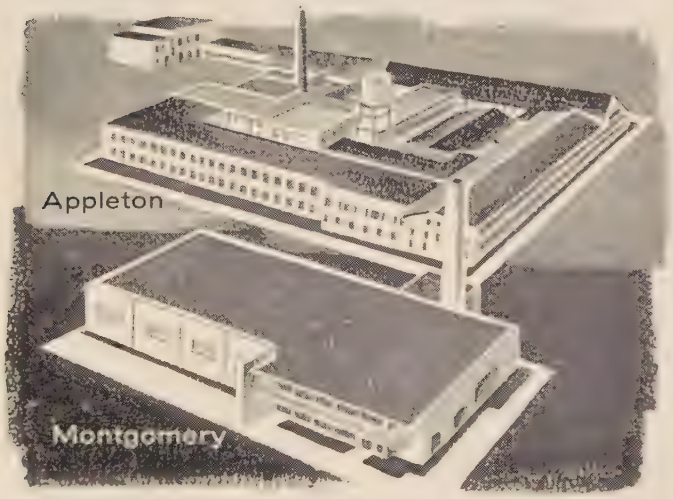

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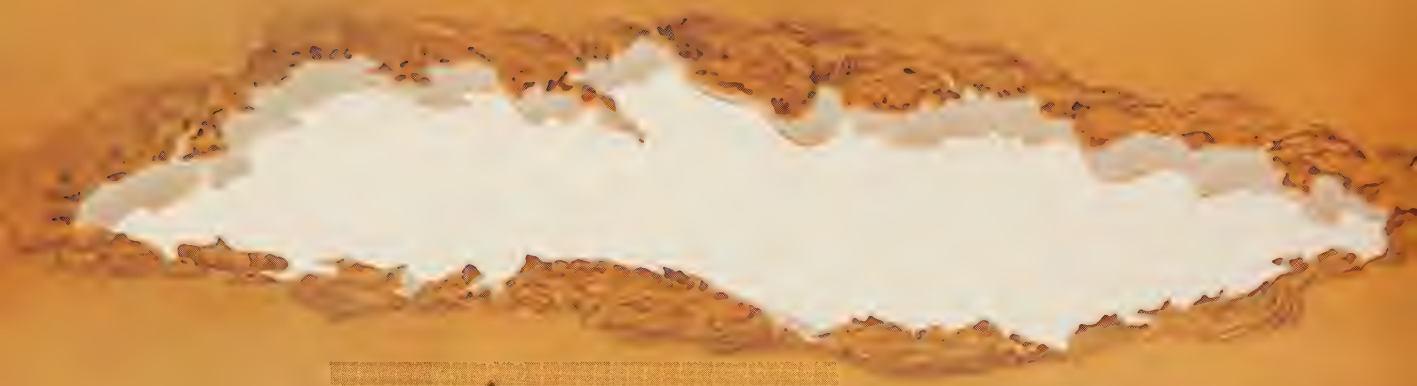

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Surface Properties of Rosin Size Precipitate

III. Electrokinetic Properties of Rosin-Sized Wood Pulp Fibers

EDWARD F. THODE and SHWE HTOO

Stream current experiments have been conducted on pads of wood pulp fibers sized with rosin-aluminum sulphate complex in order to determine the electrokinetic potential, or net surface charge, of sized fibers. Data were obtained with controlled amounts of organic and colloidal electrolytes present in the permeant water solution and these data were compared with results of electrophoresis experiments on size precipitate (in the absence of fiber). The results show that pulp in dispersion with 3.0% aluminum sulphate is negatively charged (zeta potential −4.1 m.v.), but when 2.4% rosin size is also present the charge on the size pulp is positive (zeta potential +7.9 m.v.). It is concluded that the hydrated aluminum ion is adsorbed primarily on the rosin size in the process of sizing pulp with rosin size and aluminum sulphate. Foreign materials added to the system produce changes in the electrokinetic potential of the sized pulp similar to those observed for rosin size precipitate alone. With only rosin size and aluminum sulphate present in the system along with the pulp, the electrokinetic potential of the sized fiber and the pH of the system are related. Addition of other materials complicates this relationship.

In the preceding papers in this series (*3*, *11*), the surface electric charge (more accurately, the electrokinetic potential) of rosin size precipitate was studied by means of an electrophoretic mobility technique. The influence of aluminum sulphate concentration and of the concentration of various foreign materials on the electrokinetic potential was thus evaluated. These results appeared to be directly connected with sizing efficiency. Before attempting a comprehensive interpretation of the relation of surface electrokinetic phenomena to sizing, it was decided to study the electrokinetic potential of rosin sized wood pulp and compare the effects noted in such a system with those observed for rosin-aluminum sulphate precipitate alone.

A great many investigators have studied the surface potential of cellulose; some of them have worked on sized pulp. The earliest recorded study on sized pulp is that of Ostwald and Lorenz (*10*), who made qualitative observations of the direction of travel of fibers in suspension under the influence of an applied electric field (electrophoresis). Later, Kanamaru and Tsuchida (*6*) using the method developed by Briggs (*2*) applied streaming potential measurements to a study of sized pulp. Most recent of the investigations reported in this field is that of Ninck Blok (*9*). This worker employed an electro-osmosis technique, developed after one by Briggs, to determine the electrokinetic potential of various wood pulps sized with rosins of differing free rosin content. He was principally interested in the effect of varying the type of rosin, the type of pulp, and the amount of alum added, on the electrokinetic potential and on the sizing efficiency of papers sized under comparable conditions.

Neale and Peters (*8*) in their study of streaming potentials and stream currents of fibers, overcame the principal objection to cells of the Briggs type by maintaining the same fiber concentration in the pad for all experiments. Goring, Biefer, and Mason (*4*, *5*) elaborated on the technique of Neale and Peters and eventually settled on a *stream current* method of determining the electrokinetic potential of wood pulp fibers. Briefly this experimental technique involves forming a very uniform pad of fibers on the face of one perforated electrode and then pressing the pad with another electrode. The pad and the two electrodes are contained within a glass or plastic tube of uniform bore, so that pad volume may be readily determined. A stream of solution is then forced through the pad by application of a very moderate head and the electric current produced by that flow of solution through the pad is drawn off the electrodes through an external measuring circuit of very low resistance. Different currents are observed for different pad volumes (fiber concentrations); the data may then be extrapolated to zero fiber concentration, however, and a good value for the electrokinetic potential of the fiber calculated therefrom.

The steaming potential method is not well suited for permeant solutions other than pure water because of grave difficulties in the determination of the electrical resistance of the pad. This latter measurement is not required for the stream current method. Presumably, the electro-osmosis method might be used with solutions of electrolytes, but for the fact that movable electrode cells require a very large volume of solution in the system. This large volume in proportion to the very small change in volume produced by electro-osmosis results in poor precision.

For the various reasons heretofore cited, it was decided to employ a stream current method of studying the electrokinetic potential of various systems containing wood pulp fibers, rosin-aluminum sulphate complex, and miscellaneous foreign materials.

EXPERIMENTAL PROCEDURE

The apparatus used in this investigation was a modified version of that developed by Goring and Mason. This very simple experimental setup is schematically represented in Fig. 1. Also in this figure may be seen the detail of the stream current cell itself. This cell consists of a 15-in. length of 1.000-in. precision bore Pyrex tubing of $^1/_8$-in. wall thickness. Inside this cylindrical tube ride two hollow silver pistons, $^1/_2$-in. long and just under 1 in. in diameter. The heads of these pistons are flat and are perforated with forty $^1/_{64}$-in. drilled holes. The piston bodies are drilled and tapped

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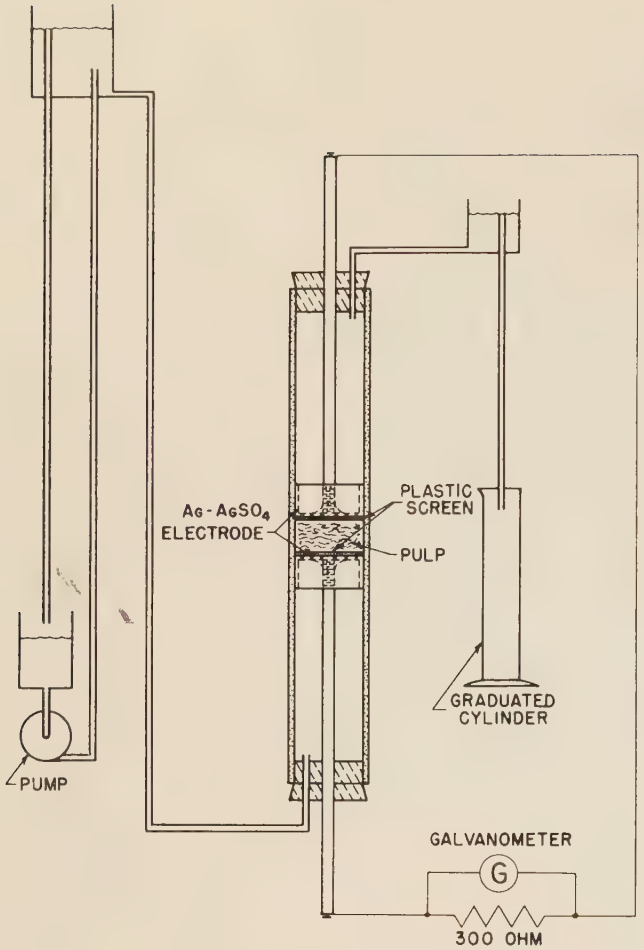

Fig. 1. Stream current apparatus

to receive a $^{3}/_{16}$-in. silver rod for mechanical and electrical connection external to the cell. Before use, the pistons and rods were anodized in sulphuric acid solution. A double layer of common vinylidine chloride-vinyl chloride copolymer monofilament (Saran) screening is attached to the surface of the electrodes to prevent consolidation of pulp fibers right at the electrode surface.

In use, the pad of pulp is compressed between the two piston electrodes, which are held in place by the perforated rubber stopper closures at the end of the tube. The tube is clamped in a vertical position and solution is introduced into the portion of the tube below the lower electrode from a constant head chamber. The difference in head between the inlet and outlet head chambers forces the solution through the pad, whence it flows through the upper electrode and out the upper end of the tube to the outlet head chamber. Overflow from this chamber is collected and measured. If necessary, this solution is then returned to the supply vessel from which liquid is pumped to the inlet head chamber.

The electric current produced by the flow of the solution through the pulp pad is conducted to a suitable shunted suspension-type galvanometer, used in conjunction with a lamp and scale indicating device. The entire measuring circuit was calibrated in order that direct conversion of scale reading to current in microamperes could be made.

The experience of a number of investigators has demonstrated that nonuniformities in the pad are the greatest obstacle to the obtaining of useful and reproducible data by the use of this type of equipment. To this end, every precaution must be taken to assure uniform pad formation, to exclude bubbles from the system, and to minimize slippage of individual fibers within the pad to a different relative position during the course of measurement (pad decay). A hardwood soda pulp with low flocculating tendency was selected for these experiments. Since very long fibers contribute to flocculation and poor formation and since short fibers and fines bring about pad decay, the unbeaten pulp was put through a two-screen separation in a Bauer-McNett classifier and only the -28 $+65$ portion used for pad making. Uniform pad formation was accomplished by dispersing the pulp to 0.167% consistency and, with the upper electrode removed, introducing the suspension into the tube from a specially designed headbox in which constant, gentle agitation was maintained.

Previous investigators of stream current phenomena have confined themselves to deaerated solutions or distilled water as the permeant liquids. Since the present work was to be related to practical sizing operations, it was thought undesirable to rid the solutions of their equilibrium content of atmospheric gases, in case these did have some effect on the process under study. Accordingly, attempts at the elimination of air were confined to the avoidance of air bubble formation in the apparatus.

In all experiments, the white water from the pad formation step was employed as the current-generating, permeant liquid. It is thus to be supposed that the permeant solution was at electrochemical equilibrium with the material in the pad. Whether or not this presupposition is correct, it is nevertheless apparent that steady state does not exist in the system immediately after initiation of flow, because the current output of the cell at first decreases rapidly with time. After some 12 or 15 min. of streaming, the current assumes a constant value. It is this value that was recorded for our purposes.

The procedure for performing a single experimental run may be summarized as follows: The classified pulp was made up to about 0.167% consistency, dispersed thoroughly by 2 min. agitation in a Waring Blendor and allowed to stand overnight. The water used was distilled water, or distilled water solution of the foreign electrolyte under study. After standing overnight, the pulp suspension was stirred gently and rosin size added in dilute (0.4%) solution in such an amount to give 2.4% rosin size on the moisture-free weight of the fiber (In blank runs this step was omitted, of course.) The suspension was again gently agitated while the 0.5% aluminum sulphate solution was added in such amount as the experiment called for, with constant stirring. This sized suspension was then permitted to stand for 3 hr., at which time it was used to form a pad in the stream current cell. The white water was transferred to the supply vessel, the pump started, and, after the upper electrode had been inserted in place, the permeant solution was forced through the pad under conditions of maximum pad volume. After determination of the equilibrium stream current value, the flow of liquid was stopped and the pad compressed by forcing the upper electrode closer to the lower. Flow of permeant solution was restarted and the new current value

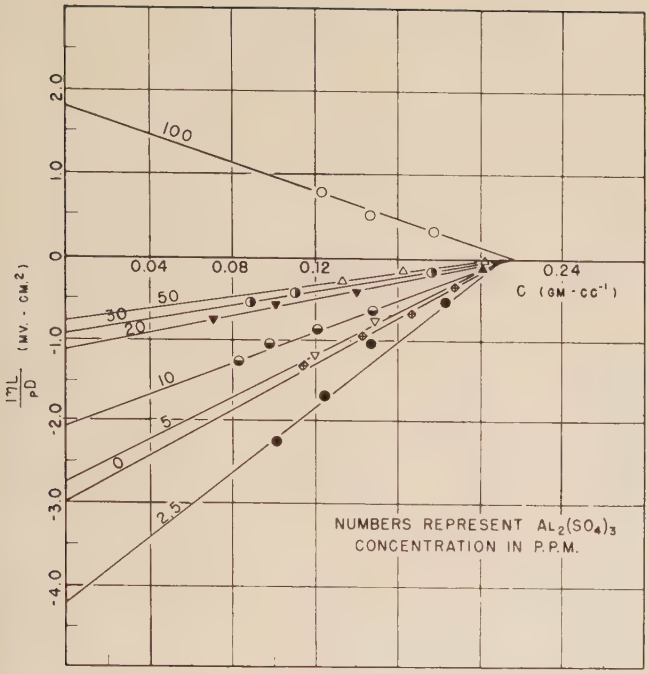

Fig. 2. $\frac{I\eta L}{pD}$ *versus C for 0.167% pulp and aluminum sulphate*

determined. These last steps were repeated four or five times until the maximum pad concentration possible with this apparatus had been reached. Meanwhile the essential data, pad thickness, head producing flow, flow of permeant solution, etc., had been recorded to permit computation of the zeta potential (electrokinetic potential) of the material in the pad, as described below. The pad was then removed from the cell and oven dried for exact determination of the weight of cellulose used.

COMPUTATION OF ELECTROKINETIC POTENTIAL

No attempt will be made here to derive the stream current equation used to compute the zeta potential or electrokinetic potential of fibers from the data obtained in the experiments just described. Those interested in a theoretical explanation of this equation and its derivation are referred to the paper by Goring and Mason (*4*). As derived therein the equation is as follows:

$$\frac{I\eta L}{pD} = \frac{A\zeta}{8\pi}(1 - \alpha c) \qquad (1)$$

where I is the stream current; η the viscosity of the permeant liquid; L, the pad thickness; p, the pressure causing flow; D, the dielectric constant of the liquid; A, the cross sectional area of the pad; ζ, the electrokinetic potential; α, the swollen specific volume of fiber; and c, the concentration of fiber in the pad.

It will be noted that if pad concentration is deliberately established as the only independent variable, then equation (1) takes the familiar form of a linear equation:

$$y = ax + b \qquad (2)$$

permitting values of the group $I\eta L/pD$ to be plotted as ordinates against values of c as abscissas. Experimental points should produce a straight line, the intercept of which on the y axis will permit calculation of ζ the electrokinetic potential.

When successive pads of pulp from the same source are tested, varying only the concentration of some electrolyte present, a family of straight lines is obtained, all these intersecting the abscissa at about the same point but cutting the ordinate axis at various points depending on the electrokinetic potential of the fiber. In Fig. 2 is shown the experimental data of one such series of runs plotted as described. This particular set of runs was made with pure unsized pulp, the only variable being the concentration of aluminum sulphate.

RESULTS

The influence of aluminum sulphate concentration on the electrokinetic potential of pure (unsized) and sized pads of soda pulp is shown in the two curves of Fig. 3. Note that the upper curve shows that sized pulp passes from a negative to a positive charge at about 17 p.p.m. aluminum sulphate, while the lower curve, for pure pulp, does not cross the zero line until an alum concentration of about 60 p.p.m. is reached. A number of experimenters have contradicted the early observation of Ostwald and Lorenz that pulp in alum solution becomes positively charged. Presumably these workers did not employ as high an alum concentration (or ratio of alum to fiber) as was tried by Ostwald and Lorenz and by the present writers.

pH observations were also made during these runs; it is interesting to note the effect of the presence of rosin size in displacing these curves. Figure 4 is a plot of electrokinetic potential of unsized (curve A) and sized (curve B) as a function of the observed pH. The dotted line (curve C) shows electrokinetic potential versus pH results obtained on sized pulp by Ninck Blok (*9*) using an electro-osmosis technique. A very good correspondence in the shape of the curves and in the location of the iso-electric point is noted between curves B and C. It is not surprising that the values of zeta potential differ in absolute units, considering the difference in computational and experimental methods used in the two different investigations. S. G. Mason has demonstrated (*7*) that the type of flow encountered in electro-osmosis differs considerably from that produced in the stream current and streaming potential methods. A somewhat different electrokinetic potential results, which is always higher for electro-osmosis than for streaming potential, depending on the void fraction in the pad. Presumably this fact accounts in large meas-

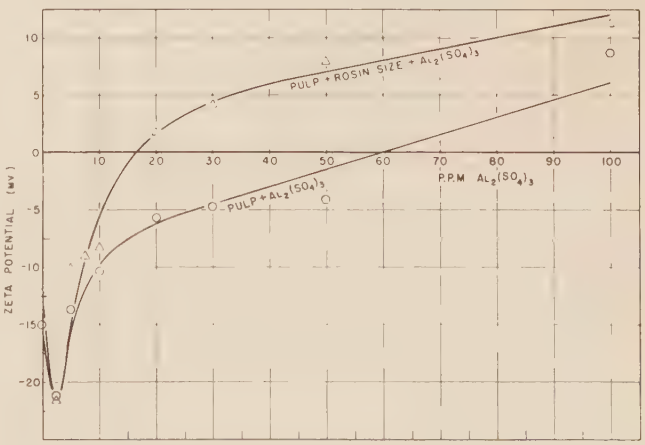

Fig. 3. Zeta potential versus conc. $Al_2(SO_4)_3$
0.167% pulp. 0.004% rosin size.

ure for the discrepancy in absolute values of zeta potential between this investigation and that of Ninck Blok.

Figure 5 compares the pH data of sized pulp of these two investigations as a function of aluminum ion concentration.

Table I lists the comparative data on the effect of various foreign electrolytic materials on the pH and zeta potential (as computed from electrophoretic mobility data) of straight rosin size precipitate. Most of these materials may possibly be found in a paper mill system, and many adversely affect sizing. The principal observation that may be made from these data is that there is no apparent relationship between pH and zeta potential once a foreign electrolyte is added to the system. Although the discrepancy between the zeta potential data for size precipitate and for sized pulp is undoubtedly real and sometimes inexplicable for several of these cases, in no event is a close coincidence to be expected between these two values because of doubt as to the validity of comparing the methods of computation used to arrive at the respective figures.

Table I. Effect of Foreign Electrolytes on the pH and Zeta Potential of Rosin-Size Precipitate and of Sized Hardwood Pulp

(0.004% Rosin Size, 0.005 to $Al_2(SO_4)_3$)

Foregn substance	Concentration	Rosin size ppt. pH	Rosin size ppt. Zeta pot.	Sized pulp pH	Sized pulp Zeta pot.
None	...	4.5	+30.0	4.4	+7.9
Sodium ligno sulphonate	0.001%	4.5	0	4.3	−6.4
Sodium ligno sulphonate	0.004%	4.4	−14.1	4.3	−3.0
Polyacrylic acid	0.001%	3.1	−16.7	4.1	−4.0
Polyacrylic acid	0.004%	2.8	−12.9	3.5	−4.2
Direct dye (C.I. 327)	0.0015%	4.5	+12.2	4.5	−5.2
Direct dye (C.I. 327)	0.0045%	4.4	−11.4	4.4	−9.4
$Na_2C_2O_4$	0.00012 molar	4.6	+23.0	4.5	+16.6
$Na_2C_2O_4$	0.003 molar	6.6	−87.0	7.3	+5.5
$Na_4P_2O_7 \cdot 10H_2O$	0.00012 molar	5.4	+8.6	4.9	−7.9
$Na_4P_2O_7 \cdot 10H_2O$	0.003 molar	9.5	−64.0	9.5	−2.3

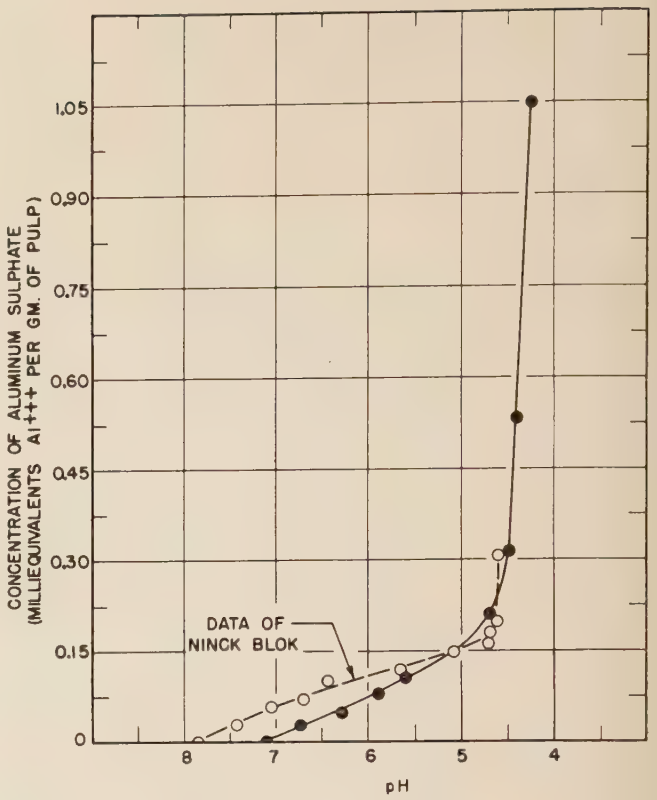

Fig. 5. Variation of pH of sized pulp suspension with aluminum sulphate concentration

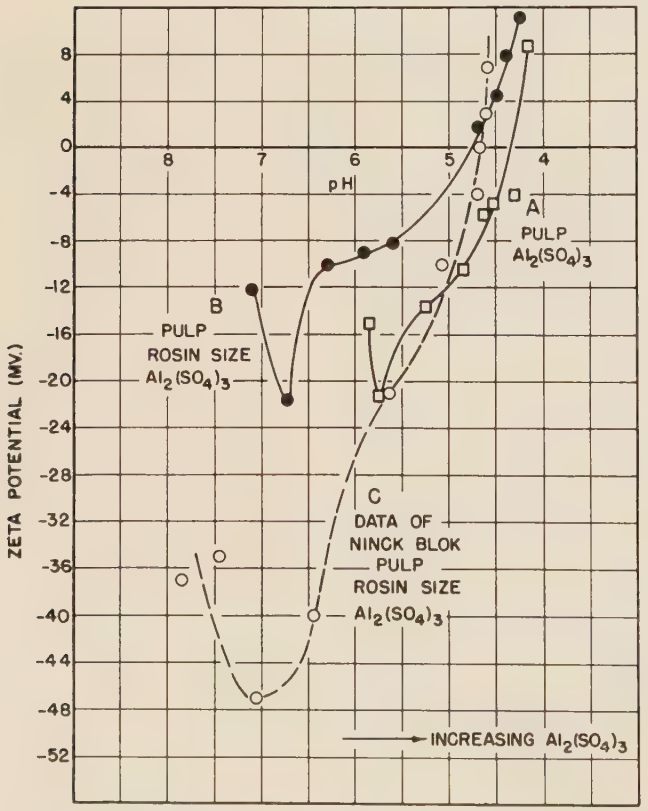

Fig. 4. Comparison of zeta potential and pH of sized and unsized pulp at varying aluminum sulphate concentrations

DISCUSSION

Of particular importance is the observation here made that pulp in the presence of rosin size and aluminum sulphate becomes positively charged at a much lower concentration of aluminum ion than does pulp in the presence of aluminum alone. This observation alters somewhat the conception that aluminum adsorbed on both fiber and rosin produces an "electrostatic adhesive" bond.

In earlier work (*11*), it was shown that rosin-aluminum sulphate complex alone becomes positively charged at a very low concentration of aluminum sulphate. This concentration is roughly in the same region (slightly lower) as that in which a positive charge on sized pulp is first noted in the present work.

It would seem a reasonable conclusion from the above observations that the role of aluminum sulphate is not so much that of serving as an adhesive as that of creating a positively charged rosin particle which can then precipitate on the negatively charged cellulose. Apparently, the positive rosin-aluminum sulphate complex is attracted to the negatively charged cellulose, and, if the concentration of hydrated aluminum ion is

sufficiently high, the precipitation of complex with an excess of positive charges brings the sized cellulose over to the positive side.

Considering the effect of aluminum sulphate in the absence of size, it is of interest to note that the fiber does become positively charged at high alum concentrations. However, at alum concentrations found at headbox consistency, the pulp might be negatively charged. One practical consequence of this effect is that at high consistencies back in the stock preparation system, there may be sufficient alum present to make the stock positively charged if added prior to the addition of the rosin size. This could conceivably alter the attraction for the pulp of the precipitate formed with rosin size. In some cases a result beneficial to sizing might result, but a detrimental effect is more likely. The wisdom of adding size *before* alum (in an uncomplicated system) would thus appear to be borne out by the electrokinetic data.

At this point one encounters an as yet unexplained anomaly: evidently, a very small amount of alum present in the water prior to addition of size is beneficial to sizing. This observation has been critically studied by Brauns (*1*), who fixes the figure at 0.2 to 0.4% alum based on the pulp. It is probably not coincidence that this figure corresponds roughly to the aluminum sulphate concentration for the most negative value of electrokinetic potential of pulp, as determined by the authors (see Fig. 3) and by Ninck Blok (*9*). While it is not yet possible to offer a full explanation for the circumstances outlined in the preceding sentences, it seems likely that an initial preferential adsorption of a negative ion takes place. What this ion may be and why this essentially transient phenomenon should affect sizing pose interesting questions for future workers.

In any event, the operation that employs white water in the stock system ahead of the point of size addition probably is in a fortunate position. In most cases there should be enough alum in the white water to carry the stock past the highly negative point just mentioned, yet the amount present ordinarily would not be sufficient to make the stock positive. Only in the few cases where excessive amounts of alum were used elsewhere in the system might one expect difficulty from the stock becoming prematurely positively charged from the white water.

Other foreign materials present in the white water may have an adverse effect on sizing efficiency, and as will be shown in the succeeding paper, this result may be connected with a decrease or reversal of the positive electrokinetic potential of the rosin size precipitate. However, these materials may adsorb in a different manner on pulp and on the size precipitate, so that trends of electrokinetic potential of sized pulp in the presence of foreign electrolytes do not always parallel the changes in the potential of the size precipitate. As a general observation, nevertheless, the two may be assumed to behave in a roughly similar manner.

When considering the purported effect of pH on the sizing phenomenon, many writers have failed to appreciate that the pH of the system may be only an effect, not a cause. The hydrogen ion concentration is affected by the hydrolysis of aluminum salts, by the reaction with rosin size, and by the base exchanging capacity of the cellulose itself. Thus, the final pH of a sizing system is the result of several chemical reactions which finally produce a fairly well buffered solution.

It has been generally agreed by many workers who report size studies that optimum sizing may be found in the pH range of 4.6 to 4.8. That observation has often been taken to mean that a pH of about 4.7 produces optimum sizing.

Actually, if materials other than cellulose, size, and alum are present, a pH of 4.7 does not necessarily produce optimum sizing. Likewise, under such conditions, a pH of 4.7 would not be expected always to produce zero electrokinetic potential of various sized pulp systems (see Table I). These data demonstrate the extent to which the electrokinetic potential may vary with addition of foreign materials with little or no concomitant variation in pH.

CONCLUSIONS

It is concluded that the influence of aluminum sulphate on sizing is that of producing a positively charged complex with rosin size; this complex then precipitates on the negatively charged cellulose by electrostatic attraction.

In a system containing 2.4% rosin size and 3.0% aluminum sulphate based on the dry weight of the fibers, a net positive potential appears on the pulp. If the rosin size is omitted, the pulp retains its normal negative character with 3.0% aluminum sulphate present. This could be due to the difference in the state of the alum in the system.

Certain foreign materials added to the sized pulp system change the electrokinetic potential of the pulp essentially in the same direction and to the same extent as they affect the electrokinetic potential of rosin size precipitate alone.

With only rosin size and aluminum salt present in the system along with the pulp, the electrokinetic potential of sized fiber and the pH of the system are related. Addition of some foreign substance alters this relationship.

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Received Feb. 9, 1955. Presented at the 40th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 21–24, 1955.

Drawn in part from a thesis presented by Maung Shwe Htoo to the Faculty of Graduate Study, University of Maine, in partial fulfillment of the requirements for the Degree of Master of Science in Chemical Engineering, June, 1954.

This investigation was carried out in the facilities of the Department of Chemical Engineering, University of Maine, under the auspices of the American Cyanamid Fellowship. The helpfulness of the American Cyanamid Co. in providing the fellowship funds and the material for study is gratefully acknowledged. The authors are indebted to J. C. Barthel, O. Brauns, J. F. Gorham, R. W. Kumler, C. G. Landes, S. G. Mason, and N. T. Woodberry for suggestions and helpful advice.

Surface Properties of Rosin Size Precipitate

IV. Influence of the Electrokinetic Potential of Rosin-Size Precipitate on Sizing Efficiency

EDWARD F. THODE, JOHN F. GORHAM, RALPH W. KUMLER, and NORMAN T. WOODBERRY

Information on the electrokinetic properties of rosin-size precipitate (rosin-aluminum sulphate complex) presented in previous papers is correlated with results of sizing tests conducted on laboratory-prepared handsheets. It is shown that changes in sizing efficiency parallel closely changes in the electrokinetic potential of rosin-aluminum sulphate complex as the proportion of aluminum sulphate to rosin size in the system is altered. Similarly, changes in sizing efficiency induced by the presence of small amounts of contaminant materials usually correlate with the changes in electrokinetic potential of the size precipitate, unless the contaminant has sizing properties of itself. It is concluded that the electrokinetic potential (or effective surface charge) of the rosin size precipitate is one of the major factors influencing sizing efficiency. In the usual pH range (4.2 to 5.5) variation in the electrokinetic potential has more effect on sizing efficiency as measured by writing ink than does change in the pH. On the basis of these findings, a modification of the electrokinetic theory of sizing is presented, and its application in explanation of practical sizing problems is discussed.

In earlier papers in this series, it was stated that the over-all objective of this particular research program was to evaluate the factors that determine the net surface charge, more accurately designated the electrokinetic potential, of rosin size precipitate. It was also hoped that the relative importance of the electrokinetic potential in the achievement of effective sizing of paper might be determined.

Interest in the influence of electric charge on sizing has been very great since Ostwald and Lorenz (*9*) offered the theory that positive alumina acts as an "electrostatic adhesive" between negatively charged cellulose and negatively charged rosin. Collins, Davis, and Rowland (*3*) offered quantitative information on the effect of pH on the electrophoretic velocity of alumina floc and on "alumina-rosin size coprecipitate" and qualitatively related this to changes in sizing efficiency.

Very recently Cobb has re-emphasized the importance of contact angle in sizing and has pointed out the part played by the coordinating tendency of aluminum in the formation of the rosin alum complex (*2*). C. J. J. Ninck Blok (*8*) has studied the relation of the electrokinetic potential of sized pulp to aluminum sulphate concentration by an electro-osmosis technique. He presented extensive quantitative comparisons between zeta potential and sizing efficiency. Earlier papers in this series (*6*, *12*) presented quantitative data on the influence of foreign ions and other foreign solutes on the electrophoretic mobility of rosin-aluminum sulphate complex and on the electrokinetic potential of sized soda pulp. Also some attempt was made in this earlier work to demonstrate quantitatively the relationship between electrokinetic potential and sizing efficiency. It is the purpose of this paper to present further quantitative evidence of the essential relationship between the net electric charge (electrokinetic potentials) of rosin size precipitate and sizing efficiency. In light of this information a modification of the electrokinetic theory of sizing is presented.

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PROCEDURE

Electrophoretic mobility data on rosin-aluminum sulphate complex (or rosin-aluminum chloride complex) were obtained as described in the paper by Thode, Gorham, and Atwood (*12*). Some of the data employed are drawn directly from one of the preceding papers in this series (*6*). Information on the electrokinetic potential of sized and unsized pulp samples was obtained by the stream current method described by Thode and Htoo in paper III of this series (*q.v.*). All data reported in this paper are for a "low free" gum rosin size with a free acid content of 11.5% (as abietic) of total solids.

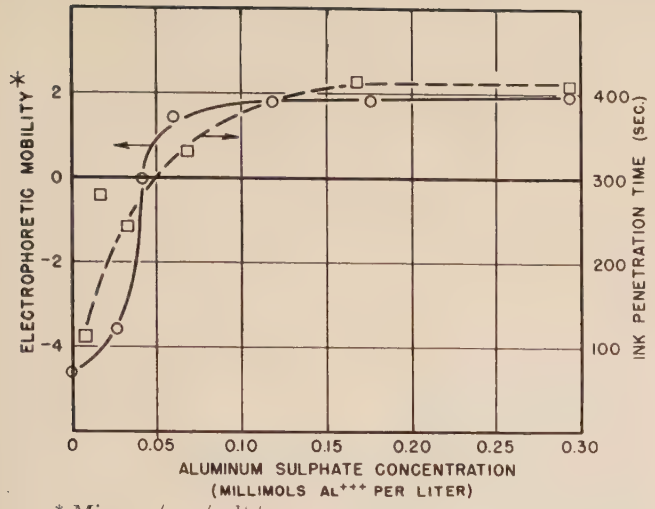
Sizing experiments were carried out on a handsheet basis under conditions simulating as closely as possible those employed in preparing the samples for electrophoretic mobility or for stream current experiments. The pulp consistency and the concentrations of rosin-size and aluminum salt were of an order of magnitude such as might be expected in the headbox of a paper machine. As a check, a few experiments were conducted in which the size precipitation was carried out at 10 times headbox consistency and then the stock diluted for sheetmaking.

The handsheet making procedure is summarized as follows:

A. Materials
   1. Stock: Mixture of sulphite and soda pulp was beaten to a freeness of 345 ml. (Green).
   2. Rosin size: A 75% solids low free gum rosin size was diluted to 5%. This was further diluted to 1.0% for use.
   3. Aluminum salts: One per cent solutions (anhydrous salt basis) of $Al_2(SO_4)_3 \cdot 18H_2O$ and $AlCl_3 \cdot 6H_2O$ (C.P. grade) were prepared. Shortly before use, these were diluted to make a 0.1% working solution.

B. Stock Preparation

The beaten pulp was diluted to about 0.20% consistency and the predetermined amount of foreign material (if any) added with constant stirring. The dilute rosin size and aluminum salt solutions were then added in that order. The stock was then adjusted to 0.167% consistency, the pH determined and then adjusted to 4.8 with appropriate amounts of NaOH or HCl. For the check runs, the same procedure was employed except that stock at 1.75% consistency was



* Microns/sec./volt/cm.

Fig. 1. Variation of electrophoretic mobility of rosin size precipitate and of sizing effectiveness with aluminum sulphate concentration

used and the aluminum salt was in the form of a 1.0% solution. In this case the consistency was adjusted to 0.167% immediately prior to sheetmaking. Fresh, demineralized water was employed in all dilutions in the handsheet machine.

C. Handsheet Preparation
Handsheets were formed in a British handsheet mold, pressed in a British press and dried on a Noble & Wood drier (felt covered drum) at 240°F.

D. Paper Testing
The dry handsheets were conditioned at least 24 hr. at 73°F. and 50% R.H. Tests include basis weight, measuring the rate of writing ink penetration by optical means using a modified Barss, Knobel, and Young news ink penetration tester, Cobb water absorption test (15 min. at 73°F.) and penescope lactic acid test (20% acid at 100°F.).

Experimental Correlation of Sizing with Electrophoretic Mobility

In Fig. 1, the results of ink penetration tests on handsheets made with a constant proportion of rosin size to fiber and with various aluminum sulphate concentrations are plotted in comparison with the related electrophoretic mobility data taken from earlier work (*6*). (Note in all figures of this type, the convention has been adopted of matching ordinates by arbitrarily beginning about the same level for maximum mobility and maximum sizing.) It may be noted that in all cases the rosin size concentration was 0.004% (2.4% on the pulp), corresponding to an approximate molarity of 0.00013.

In studying Fig. 1, it may be noticed that the region of most rapid change in mobility with concentration corresponds to an aluminum ion molarity of 0.00003 to 0.00004 (neglecting hydrolysis). This region of most rapid change included the point of zero mobility, or point of zero net charge on the precipitate. The region of most rapid increase in sizing likewise occurs at about the same aluminum ion concentration and includes most of the effect produced by the size. It can be referred to as the zone of minimum concentration for appreciable sizing effectiveness.

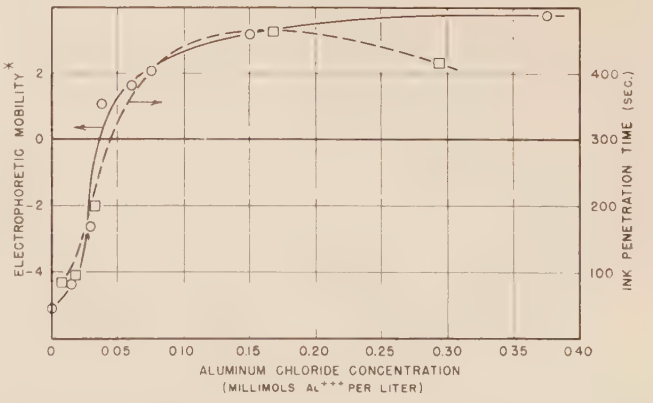
Table I-A restates the results observed in Fig. 1. In this table rates of change of mobility and of pH with respect to aluminum ion molarity are presented. These figures were obtained by dividing the incremental change in each factor (negative in sign for pH) by the concentration increment tabulated. The median concentration for each incremental concentration range is also tabulated in terms of mol ratio of rosin size (as abietic acid) to aluminum sulphate. It may be observed that the most rapid rise in electrokinetic potential of the rosin size precipitate and the most rapid drop in pH occur as sufficient aluminum is added to bring the mol ratio of rosin size to aluminum down to 5 : 1

Table I-A. Rate of Change of pH and of Electrokinetic Potential of Rosin Size Precipitate with Addition of Aluminum Sulphate

Conc. range of precipitation, millimols Al/l.	*Mol ratio rosin : Al (median)*	*$\Delta pH/\Delta C$ units, millimol/l.*	*$\Delta\zeta/\Delta C$ mob. units/ millimol/l.*
0 –0.0117	22.5	−6.8	104
0.0117–0.0234	7.4	−13.6	82
0.0234–0.0292	5.0	−86.1	287
0.0292–0.0410	3.7	−57.3	184
0.0410–0.0585	2.6	−10.3	4

That the most rapid increase in sizing, the most rapid increase in electrokinetic potential, and the most rapid drop in pH (of size-alum system) all occur at the 5 : 1 to 4 : 1 range of mol ratios of rosin to aluminum is more than coincidence. Back and Steenberg (*1*) have demonstrated that at high ratios of abietic acid to aluminum, the precipitate formed is a mixture of aluminum diabietate and free abietic acid. As the mol ratio of basic aluminum diabietate to abietic acid is increased above an aluminum diabietate proportion of about 20 to 25%, the contact angle of the precipitate with water rises from 71 to 86°. A gross mol ratio of rosin size to aluminum of 5 : 1 is equivalent to 25 mol per cent aluminum dirosinate mixed with rosin acid. It appears from our sizing data that when sufficient aluminum is present to give 25% of dirosinate in the precipitate a good sizing effect is obtained, presumably because the maximum possible rosin-water contact angle is obtained.

The chemical reaction of precipitation of sodium resinate by aluminum sulphate has been explored by Back and Steenberg who conclude that "the precipitation of a solution of pure sodium abietate with aluminum sulphate results in a product with the over-all composition of $Al(OH)Ab_2 + HAb$, very near that of $AlAb_3$." According to the data of this investigation over 80% of the maximum sizing effect and, likewise, over 80% of the change in mobility noted upon addition of aluminum sulphate is obtained when enough



* Microns/sec./volt/cm.

Fig. 2. Variation of electrophoretic mobility of rosin size precipitate and of sizing effectiveness with aluminum chloride concentration

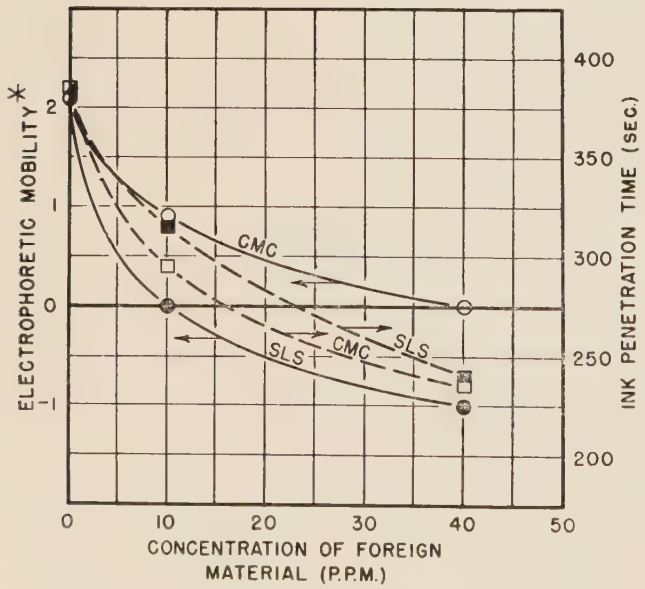
Table I-B. Rate of Change of pH and of Electrokinetic Potential of Rosin Size Precipitate with Addition of Aluminum Chloride

Conc. range of precipitation, millimols Al/l.	*Mol ratio rosin: Al (median)*	*$\Delta pH/\Delta C$ units, millimol/l.*	*$\Delta\delta/\Delta C$ mob. units/ millimol/l.*
0 –0.015	17.3	−12.0	42
0.015 –0.030	5.2	−21.3	114
0.030 –0.0375	3.9	−77.4	490
0.0375–0.0525	2.9	−16.7	25
0.0525–0.060	2.3	−26.7	31

aluminum is present to convert all the rosin size to Back and Steenberg's product.

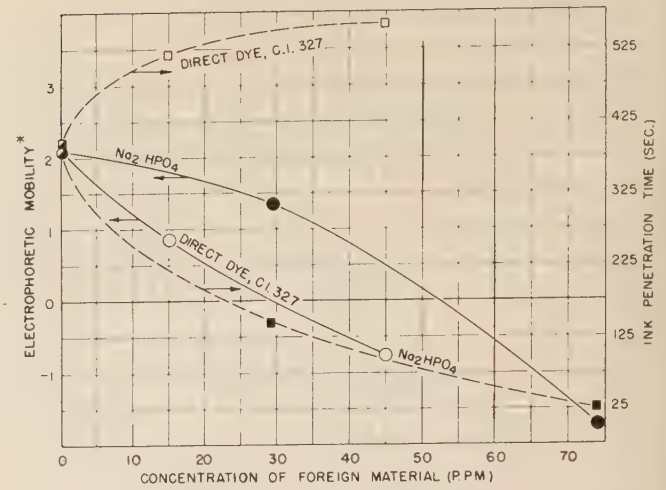
It is further noted by Back and Steenberg that the diabietate-abietic acid precipitate shows a tendency slowly to convert to the mono-abietate. Ekwall and Bruun (*4, 5*) have cast films of the monoabietate and studied its adsorption. They state that the monorosinate is more water repellent than the di or tri-rosinate. In this investigation, maximum sizing and the stable value of electrokinetic potential of the rosin size precipitate were both achieved at about a 1:1 rosin size aluminum ratio, suggesting that enough aluminum must be present in the gross complex to allow complete conversion to the monorosinate.

Figure 2 shows the same type of data as Fig. 1 for sizing with aluminum chloride while Table I-B elaborates on pH and mobility changes in the presence of aluminum chloride. The correspondence of sizing efficiency with electrophoretic mobility is almost as good as in the case of aluminum sulphate, and the same trends may be observed. The range of aluminum ion molarities of about 0.00003 to 0.00004 again is observed to provide the rapid increase in mobility, while *maximum* sizing and mobility again fall in the 0.0001 to 0.00015 aluminum ion molarity region. The generalized conclusions about the formation of aluminum di- and monorosinate drawn above are thus strengthened



* Microns/sec./volt/cm.

Fig. 3. Influence of added foreign material on electrophoretic mobility of rosin size precipitate and on sizing efficiency. (Carboxymethyl cellulose and sodium lignosulphonate)



* Microns/sec./volt/cm.

Fig. 4. Influence of added foreign material on the electrophoretic mobility of rosin size precipitate and on sizing efficiency (direct dye CI 327 and disodium phosphate)

by these observations on rosin-aluminum chloride complex.

FOREIGN MATERIALS

The correspondence between the effects produced by aluminum salts on the electrophoretic mobility of rosin size precipitate and on the sizing efficiency of the precipitate in paper may be duplicated when certain foreign materials are present in the water in which size precipitate of normal composition is formed. In Fig. 3 are presented data showing the effect of sodium lignosulphonate and of carboxymethylcellulose on mobility and sizing efficiency. Both these materials reduce and eventually reverse the normal positive charge on rosin-aluminum sulphate complex. Both reduce sizing efficiency in a comparable manner.

As shown in Fig. 4, however, the correspondence between the mobility and sizing efficiency does not necessarily exist when the foreign material has some effect other than an alteration of the electrokinetic potential of the rosin size precipitate. Both of the foreign materials added in this case, disodium monohydrogen phosphate and a direct dye, Color Index 327, reduced the positive charge of rosin-aluminum sulphate complex. However, the phosphate had an adverse effect on sizing quite out of proportion to its tendency toward electronegativity, while the red dye* actually *increased* sizing efficiencies even at a concentration which produced negatively charged size precipitate and negatively charged pulp (see previous paper). These discrepancies are readily explained:

1. The phosphate tends to precipitate out aluminum as a complex not useful in sizing. It is not at all certain what is being measured when mobilities are determined on this system.

2. On the other hand, the particular dyestuff here used is a very high molecular-weight multivalent anion with a high affinity for cellulose. The dye molecule can bond firmly to cellulose in spite of the repulsion of like charges if the potentials are merely reasonably low. Presumably the dye-alum complex and the rosin-alum

* C.I. 327 such as Calcomine Scarlet F-4BSY or Benzo Fast Scarlet 4BSA.

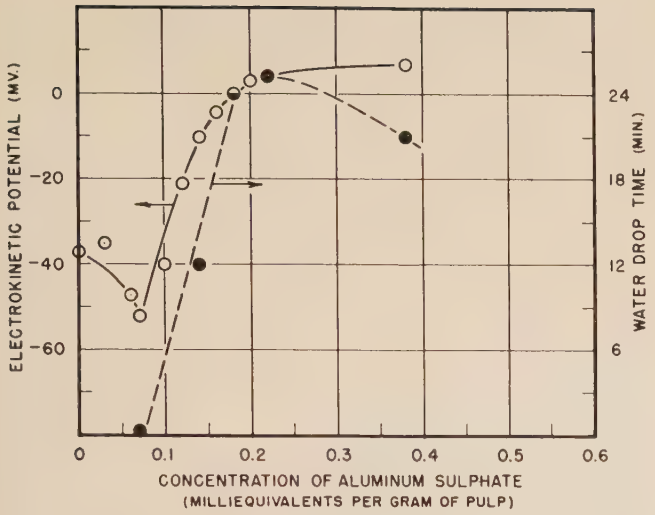


Fig. 5. Electrokinetic potential of sized pulp compared with sizing effectiveness as influenced by aluminum sulphate concentration. (Data of Ninck Blok (8))

complex are inextricably mixed up and are bonded to the fiber by the dye-cellulose affinity. If enough dye is present, the total charges on the system may be negative even though there is enough aluminum present to form aluminum monorosinate. If, in addition, the dye-alum complex has sizing properties itself, a gain in sizing is possible.

It must be emphasized that all of these comparisons have been made with regard to sizing carried out at a very low consistency, corresponding to sheetmaking concentrations. At the concentrations encountered in the beater or other parts of the stock preparation system back of the machine, it is to be expected that rosin-aluminum sulphate precipitate will form a floc, possibly voluminous. If formation of this floc aids mechanical retention, then better sizing should be expected for pulp treated with size and alum at beater consistency, than diluted for sheetmaking. The experiments here conducted bore out this point, in most cases. The unfavorable effects of sodium lignosulphonate and carboxymethylcellulose, for example, were less pronounced, percentagewise, for the stock treated at higher consistency. Nevertheless, in spite of a possible clouding of the situation by the mechanical retention of floc, all *trends* were the same for the high consistency stock as for the low. These observations indicate that mechanical filtration may be a minor factor in sizing but many observations of diverse conditions must be made before a definite statement on this point is warranted.

SIZING EFFICIENCY AND THE ELECTROKINETIC POTENTIAL OF SIZED PULP

In order to determine whether a relationship between sizing efficiency and electrokinetic potential exists, these two variables may be plotted against the common variable, aluminum sulphate concentration. In Fig. 5 the data of Ninck Blok (*8*) are so presented. This figure shows the zeta potential (electrokinetic potential) of an aspen cellulose sized with a low free rosin size and the relative sizing of various papers made with such pulp, as a function of the amount of alum used. The alum percentage was expressed as milli-equivalents of hydrated aluminum ion per gram of cellulose, where three "equivalents" of aluminum ion are assumed for each gram-atom of aluminum in the salt added. Shown in Fig. 6 are comparable data as obtained by the present authors.

The important observations about the information shown in Figs. 5 and 6 are that the two investigations agree exactly on the alum concentration (0.18 meq. per gram pulp) at the isoelectric point (region of no net charge on the pulp) and that the region of maximum sizing corresponds to this isoelectric point. In the present work this is an aluminum sulphate concentration of 0.1 millimol per liter or, roughly, 17 p.p.m

Also, the similarity of the shapes of the curves indicates that sizing efficiency is related to the electrokinetic potential. This relationship is more exactly described when these two variables are plotted against one another as shown in Fig. 7.

For the sake of discussion it should be pointed out that Ninck Blok found a considerable variation in the isoelectric point, depending on the size employed and the pulp being sized. However, that part of his data shown here is for a rosin size comparable to that used in this investigation (the other two sizes studied by Ninck Blok were casein stabilized high-free rosin sizes for which one would anticipate differing electrokinetic properties) and for an aspen pulp—the nearest thing he studied to our hardwood soda pulp. For his two softwood pulps, one regular grade, the other apparently a high-alpha pulp, Ninck Blok reported isoelectric points with low free rosin at 0.22 and 0.14 meq. Al per gram cellulose.

The correlation of observations of the current investigation with those of Ninck Blok supports the conclusion that maximum sizing is achieved by that alum concentration which brings the pulp to (or near) the isoelectric point.

INFLUENCE OF pH ON SIZING

The pH influences sizing in that it is connected with the hydrolysis of aluminum salts and the interaction of rosin size with these aluminum salts. Both Collins, *et al.* (*3*) and Ninck Blok have studied the effect of substituting acid for aluminum salts on the electrokinetic potential of rosin sized systems. A comparison of the

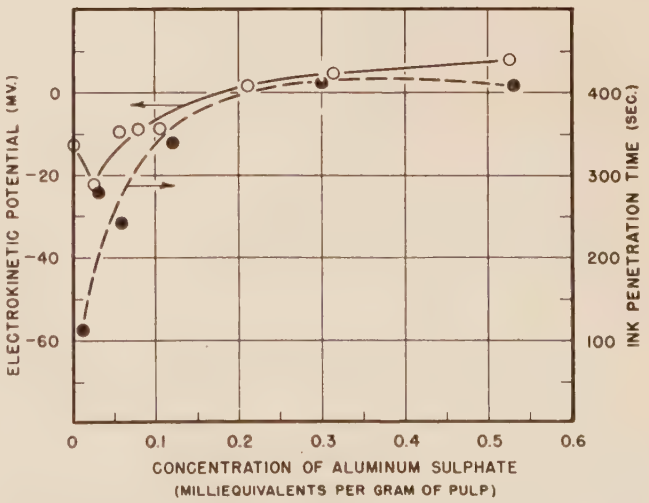


Fig. 6. Electrokinetic potential of sized pulp compared with sizing effectiveness as influenced by aluminum sulphate concentration

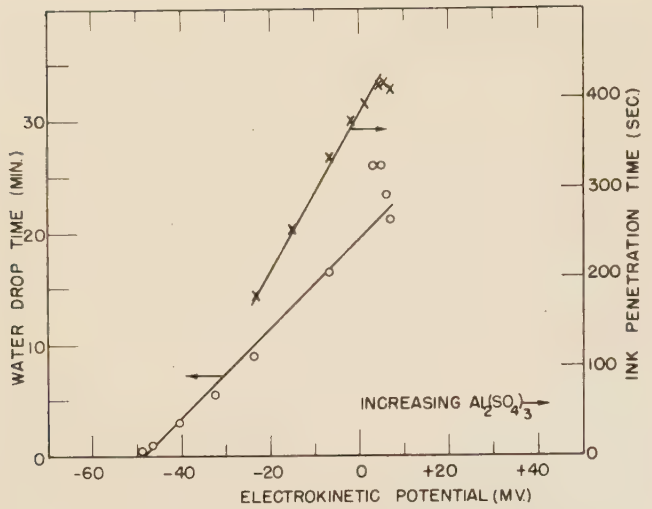


Fig. 7. Direct comparison of sizing efficiency as measured by water and ink penetration with the electrokinetic potential at varying aluminum sulphate concentration

various data on the subject may be found in Tables II-A and II-B.

From these data it may immediately be seen that size precipitated by acid is still electronegative in the pH range in which aluminum salts bring about a complete neutralization of potential. Also pulp containing size precipitated by acid is still strongly electronegative at pH 4.7 instead of having zero potential as when precipitated with alum.

It is, of course, well known that very poor sizing is obtained with acid precipitated size as compared with that precipitated by alum. It appears that the strong electronegativity of the size precipitate resulting from substitution of acid for alum is the reason for this poor sizing.

Further support of this hypothesis may be found in the data on influence of foreign materials given in Fig. 3. Here, the pH was unaffected by the presence of contaminants but the electrokinetic potential of both size precipitate and of sized pulp was changed (became more electronegative) and the sizing was adversely affected to a similar degree.

SUGGESTIONS CONCERNING THE ELECTROKINETIC THEORY OF ROSIN SIZING

It may be that the foregoing observations do not warrant extensive theorizing, but the following is offered as a frame-work for thinking on the subject:

The first step in the formation of a rosin size precipitate useful for sizing is the formation of a positively charged hydrated complex by the rosin (saponified and unsaponified) and the hydrated aluminum ions. This complex must contain aluminum in a sufficient amount to yield 25% aluminum dirosinate if a sizing effect is

Table II-A. pH at Isoelectric Point of Rosin Size Precipitated by Various Agents

Investigator	*Agent*	*pH*
Thode, *et al.*	Aluminum sulphate	5.5
Thode, *et al.*	Aluminum chloride	5.7
Collins, *et al.* (*3*)	Aluminum sulphate	5.5
Collins, *et al.* (*3*)	Aluminum chloride	5.8
Collins, *et al.* (*3*)	Sulphuric acid	2.8
Collins, *et al.* (*3*)	Hydrochloric acid	3.5

Table II-B. Electrokinetic Potential of Rosin-Sized Pulp at pH 4.7 Following Precipitation by Various Agents

Investigator	*Wood species*	*Agent*	*Zeta potential (mv.)*
Thode, *et al.*	Hardwood	Alum	0
Ninck Blok (*8*)	Aspen	Alum	0
Ninck Blok (*8*)	Spruce	Alum	+6
Ninck Blok (*8*)	Spruce	Alum + H_2SO_4	−20
Ninck Blok (*8*)	Spruce	H_2SO_4	−35

to be noted. For maximum sizing effect, sufficient aluminum to form the monoresinate is required.

The second step in sizing is the precipitation of this positively charged complex on the cellulose through the phenomenon of attraction of unlike charges. For maximum sizing effect, the final system should be near electric neutrality or be slightly positive.

The third step involves hydrolysis to form the ultimate sizing agent (presumably largely monorosinate).

As here presented, the explanation of sizing discounts any direct influence of alumina, as such, on sizing and also discounts the importance of pH, in itself, as a significant variable. Virtually all the observations made by competent previous investigators may be reconciled with this theory, even though the conclusions here reached may differ from those of some other investigators.

For example, a great many workers have found evidence of alumina in the sizing system and in sized paper. The indications are that this alumina is bound up with the hydrated aluminum monorosinate-type complex and has no bearing on the situation as alumina. Along this line, Back and Steenberg (*1*) feel that it is aluminum dirosinate and monorosinate in the sized paper which confers the sizing tendency.

Probably the best argument against any significant influence of alumina in the effective precipitation of size may be drawn from the results of Hester, Bridge, and Harrison (*7*).

It is well known that the temperature coefficient on the reaction of hydrolysis of aluminum sulphate is considerable, so that much less alum is required to obtain a given pH at elevated temperatures than at room temperatures. Assuming no interference from foreign electrolytes, the pH should indicate the amount of hydrogen ion caused by the hydrolysis and thus should also indicate the amount of alumina or alumina-aluminum sulphate complex.

Hester, Bridge, and Harrison made sizing tests on a number of pulps sized and made into handsheets at 55°C. and at 25°C. In one set of tests the same amount of alum was used at both temperatures. The pH was, of course, lower at 55°C., and the aluminum ion concentration must have been somewhat lower because of the extensive hydrolysis. Nevertheless, except for one pulp, sizing of the paper was as good at 55°C. as it was at 25°C. In the other set of experiments, however, only enough alum was added at the 55°C. to obtain the same pH as was observed for the 25° sizing. Presumably this procedure resulted in the same alumina concentration at both temperatures but a very much reduced aluminum ion concentration at the elevated temperature. Slack sizing was encountered for all pulps at the elevated temperature in this case.

These experiments effectively demonstrate that an aluminum ion, not alumina, is required for the proper precipitation of size.

APPLICATION TO PRACTICE

The significance of any theoretical and fundamental exposition is far better appreciated if the applications to practice are discussed. A few examples should suffice to see how this electrokinetic theory of sizing ties in with practical problems:

Sizing Rag Paper

It is well known that rag paper is very difficult to size and that any high alpha paper is likewise very difficult to size unless beaten long and hard. In the light of this theory and the work of Ekwall and Bruun (*5*), the explanation of this problem is readily seen. Ekwall and Bruun have pointed out that between pH 3.5 and 5.0 the uptake of aluminum per gram of cellulose varies directly as the pH and is strongly affected by the number of "acid groups" on the cellulose. Paper with few "acid groups" has a very low uptake at any pH short of that at which alumina precipitates. Presumably what applies to aluminum ion uptake also applies to the uptake of positively charged rosin-aluminum sulphate complex. Thus, a highly purified pulp, with few "acid groups" present, would be expected to take up little size precipitate.

Effect of Beating

The better sizing accomplished with beaten pulp has long been thought to be a matter of the generally lowered porosity of the sheet plus a greater ability of the fibrillated pulp to retain the floc of size precipitate. While these effects are undoubtedly important, another effect should not be overlooked, namely that the new surface exposed on beating may have a greater uptake: not only per gram, but per unit area than the undisturbed fiber skin. Thode, Beamesderfer, and Chase (*11*) have shown that the surface exposed on beating has a greater affinity for certain direct dyes than does the surface of the unbeaten fibers, in the case of steam dried pulp. This effect is only occasionally found with slush pulp (*10*). It may be speculated, at least, that the exposure or creation of extra "acid groups" or active centers on beating helps fix the size precipitate.

AGITATION AFTER SIZE PRECIPITATION

It is known that excessive mechanical working of the pulp after precipitation of the size is bad for sizing. It has very reasonably been theorized that the agitation breaks the size particles loose from the fibers, but what has not been explained is why these particles do not reattach themselves by some process similar to that causing the original precipitation. From the theory and data here presented, one possible explanation is that too much aluminum salt in the system may hinder reattachment. In the majority of sizing systems, a very considerable excess of aluminum is present over the minimum required for precipitation of the rosin size. While the minimum amount, according to the data reported by Thode and Htoo (*q. v.*), will not bring about a positive charge on the cellulose, it is possible to obtain positively charged cellulose with excess alum. Now, even if excess alum is used, it is usually metered in sufficiently slowly so that, what with the rapid reaction with the rosin size, there may not be a sufficient concentration of aluminum ion present to cause a positive charge on the cellulose during the brief interval of initial precipitation. Thus the size precipitate is positive and is attracted to the negative cellulose. However, when a particle of size complex is knocked off the cellulose after excess aluminum salt is present, the pulp would become positively charged and repel size precipitate.

pH Control of Sizing

One of the principal themes of this work is that control of the pH of the paper machine stock may not be enough for sizing purposes if other, uncontrolled variables are permitted to change the amount of aluminum ion available for size precipitation. As emphasized by the data of Hester, Bridge, and Harrison, merely a change in the process water temperature may invalidate pH control. Certainly, the unexpected incursion of some foreign electrolytes in minor amounts may drastically reduce sizing without showing up on the pH record. Such a small thing as a change in the source of supply of some filler or other furnish ingredient may bring about this latter effect.

It is not to be assumed, furthermore, that strict control of aluminum addition—by proportional metering etc.—coupled with pH control by acid addition will always be effective in the control of sizing efficiency. If in controlling the pH the amount of acid used varies widely, it is obvious that the variations in anion concentration, especially multivalent anions, can affect the electrokinetic potential and in turn the sizing efficiency.

Much as the authors would like to propose a sweeping cure for the above conditions, the state of knowledge at the present time does not permit such action. It is believed that the correlated ideas here presented on the role of the electrokinetic potential may be helpful to others in working toward such a solution.

CONCLUSIONS

It is concluded that the electrokinetic potential of rosin size precipitate is responsible for its attachment to cellulose fibers and that the potential of the resulting sized fiber is an indication of how well the fiber is sized. The lowest ratio of aluminum ion to rosin size producing good sizing also is that which converts the sign on size precipitate from negative to positive and corresponds closely to the lowest aluminum to rosin size ratio found, by other workers, to produce the optimum contact angle of aluminum di-abietate abietic acid mixture against water. A 1:1 ratio of hydrated aluminum ion to rosin size was found to produce *best* sizing and a stable value of the potential of rosin size precipitate (in the absence of fiber). This ratio likewise produced a zero electrokinetic potential for sized pulp. These observations favor the theory that aluminum monorosinate is the important agent in rosin sizing of paper

While pH is acknowledged to have an influence on sizing effectiveness, particularly as it affects the ability of the "acid groups" of cellulose to take up aluminum complexes, it is held that pH is a result of the various reactions in the system and not a controlling factor. It is demonstrated that pH and electrokinetic potential

are not necessarily related in real sizing systems and that the electrokinetic potential appears to bear the closer relationship to sizing efficiency, at least within the usual sizing pH range.

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Received Feb. 9, 1955. Presented at the 40th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 21–24, 1955.

This technical paper represents a joint contribution of the University of Maine and of the American Cyanamid Co. and is based on experimental data obtained in the facilities of the Department of Chemical Engineering, University of Maine, and of the Product Research Department, Stamford Research Laboratories, American Cyanamid Co. The authors are indebted to the American Cyanamid Co. for financial support of the investigation and for permission to publish the results herein presented. The helpful suggestions of many colleagues, particularly Ernst Back, C. J. J. Ninck Blok, T. T. Collins, Jr., and C. G. Landes, are gratefully acknowledged. The authors also wish to thank Maung Shwe Htoo and Laurence Kepler for assistance in obtaining some of the experimental data.

Gas Adsorption by Wood, Pulp, and Paper

II. The Application of Gas Adsorption Techniques to the Study of the Area and Structure of Pulps and the Unbonded and Bonded Area of Paper

WILLIAM R. HASELTON

The use of nitrogen adsorption techniques for area and structure studies on wood cellulose and pulp and for bonded and unbonded area measurements on paper is described. Pore volume distributions and specific surface areas of samples of porous chlorite holocellulose and KOH-extracted chlorite holocellulose dried from benzene were determined, and the effect of adsorbed moisture on the internal area accessible to gas was investigated. A study of the specific scattering coefficients and nitrogen adsorption areas of pulp handsheets demonstrated that a good linear correlation exists between these two methods of determining unbonded area. Estimates of the external specific surface area of unbonded pulp fibers dried from water were found to be considerably lower than the area determined by the silvering method. The estimated specific scattering coefficient of these same fibers was also markedly lower than the specific scattering coefficient of similar fibers dried from butanol. Electron micrographs showed that this difference in optical scattering was due, in part, to the presence of more erect surface fibrillation on fibers dried from butanol than on those dried from water. Percentage bonded areas of standard handsheets were estimated by nitrogen adsorption methods, the regular optical method, and a modified optical technique involving an empirical correction of the specific scattering coefficient of the unbonded fibers dried from butanol.

The first paper of this series (*1*) dealt with the nature of the low-temperature adsorption of nitrogen, butane, and carbon dioxide by wood and its major components. It was concluded that nitrogen adsorption measurements and the Brunauer, Emmett, and Teller (B.E.T.) method of computing surface area provide the most satisfactory combination for area and structure studies on cellulosic materials.

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When nitrogen adsorption is employed for area studies, the surface area accessible to nitrogen molecules of approximately 4.3-A thickness is determined. If the polar, hydrogen, and chemical bonding forces discussed by Mark (*2*) are responsible for the bonding within pulp fibers in addition to the interfiber bonding in paper, then those internal and external portions of fibers actually bonded are separated by distances of 4 to 5 A or less. Therefore, it is reasonable to believe that nitrogen is not adsorbed on areas involved in bonding and that adsorption methods may provide an excellent tool for the measurement of the unbonded internal and external area of cellulosic materials.

The present investigation had two main objectives. (1) Nitrogen adsorption data were employed to study the area and pore volume distribution of samples of porous sprucewood, chlorite holocellulose, and KOH-extracted chlorite holocellulose (dried after solvent exchange from water to benzene) and to investigate the effect of absorbed moisture on the internal area accessible to gas. (2) A study was made of the external specific surface area of pulp fibers and the bonded and unbonded area of pulp handsheets. In conjunction with this latter work, it was desired to check several of the assumptions which are made in applying the optical method of evaluating bonded area developed by Parsons (*3*) and to compare optical area values with estimates obtained using gas adsorption techniques.

AREA STUDIES ON CELLULOSIC MATERIALS EMPLOYING NITROGEN ADSORPTION METHODS

Emmett and DeWitt (*4*) were the first to measure the area of a cellulosic material employing nitrogen adsorption at −195°C. and the B.E.T. method. These workers obtained areas of 0.61 and 1.59 sq. m. per gram

for two different samples of electrical insulation paper. Haywood (*5*) employed a similar technique to measure the area of hardwood ray-cell samples dried from water and from acetone.

The areas of the water-dried* bonded ray cells ranged from 1.1 to 3.2 sq. m. per gram; whereas the same samples dried from acetone, and quite probably in a relatively unbonded, slightly porous condition, had areas of 3.0 to 7.1 sq. m. per gram.

The area and structure of cotton have also been studied by means of nitrogen adsorption measurements. Rowen and Blaine (*6*) found an external specific surface of 0.72 sq. m. per gram for cotton linters. Assaf, Haas, and Purves (*7*) reported a method of displacing water from caustic-swollen cotton with methanol and subsequently replacing the methanol with benzene before drying which rendered a large portion of the internal area of the fibers accessible to nitrogen. B.E.T. areas of 53.0 and 64.6 sq. m. per gram were obtained for two samples of linters treated in this way. Hunt, Blaine, and Rowen (*8*) also employed this displacement technique to investigate the internal area and structure of cotton linters. Specimens of cotton having an original area of approximately 0.6 sq. m. per gram were swollen in water and in 10% caustic solution and dried after replacement of the water with methanol and benzene. Areas of 47.3 and 71.3 sq. m. per gram were obtained for the benzene-dried linters swollen in water and caustic, respectively. From the nitrogen adsorption isotherms, the distribution of internal pore size was determined using a technique suggested by Wheeler (*9*) and outlined by Shull (*10*). The samples of benzene-dried cotton were found to contain a preponderance of exposed pores of 20 to 55 A diameter with a peak in the distribution curves occurring between 30 and 40 A. When the caustic-swollen, benzene-dried cotton was permitted to absorb 3.3% moisture, the measured area was reduced to 31.6 sq. m. per gram. On further conditioning of the same sample to a moisture takeup of 11%, the B.E.T. area was 2.0 sq. m. per gram.

METHODS EMPLOYED TO MEASURE THE EXTERNAL SPECIFIC SURFACE OF PULP FIBERS AND THE BONDED AREA OF PAPER

During the past 20 years, a number of different methods have been investigated for the determination of the external surface area of pulp fibers.

A microscopic technique was employed by Graff, Schlosser, and Nihlen (*11*) to estimate the visible external surface of various types of pulp fibers. The adsorption of stearic acid from benzene solution by filter paper was studied by Stamm and Millett (*12*) as a means of measuring the external surface area of cellulosic materials. More recently Beamesderfer, Thode, Chase, and Hubbard (*13*) employed the adsorption of Benzo Fast Scarlet dye as a measure of the surface area of unbeaten sulphite pulp. Through use of a water permeability technique, Robertson and Mason (*14*) and Ingmanson (*15*) determined the external area of wet pulp fibers. Similarly, Brown (*16*) estimated the exposed surface area of dry pulp fibers from air permeability measurements. The method of determining the specific surface of cellulosic materials which has been most widely used, however, is the silvering method devised by Clark (*17*) and subsequently modified by McEwen (*18*), Browning and Baker (*19*), and Browning (*20*). Optical methods utilizing the scattering of light were studied by Mason, Vivian, and Maass (*21*) with the object of determining the specific surface of pulp suspended in water.

The measurement of bonded area by optical methods was first undertaken by Parsons (*3*). This technique assumed that all of the external surface area of the fibers in a paper sheet that is in optical contact and does not scatter light is bonded and that a determination of the difference in the specific scattering coefficients of regular and unbonded butanol-formed pulp sheets will permit an estimation of relative bonded area. Numerical values of bonded area are obtained only by using the silvering method to measure the external specific surface of the pulp. The method was altered slightly and used by Ratliff (*22*) to study the properties of bleached kraft pulps. Van den Akker (*23*) suggested that better formation of the butanol sheets and consequently more accurate bonded area estimates would result if the sheets were formed in water and the water was displaced from the pulp by successive applications of acetone and butanol. With this modification and with the substitution of benzene for butanol, Keeney (*24*) and Leech (*25*) used the technique for bonded area studies. Other than several estimates made by Brown (*16*) from air permeability data, this optical method is the only means which has been employed to estimate the bonded area of paper.

INVESTIGATION OF THE INTERNAL AREA AND STRUCTURE OF BENZENE-DRIED SPRUCEWOOD, CHLORITE HOLOCELLULOSE, AND KOH-EXTRACTED CHLORITE HOLOCELLULOSE

Experimental Procedures

Samples of 40 to 100-mesh sprucewood, chlorite holocellulose, and KOH-extracted chlorite holocellulose, similar to the materials discussed in the previous paper, were dried from benzene in the manner described by Assaf, Haas, and Purves (*7*). Each material was soaked in distilled water, drained, and stirred into commercial 99% methanol. The operation was repeated with 99% methanol, methanol dried by distillation over magnesium, and two successive quantities of sodium-dried benzene. Following the final treatment, the benzene was thoroughly drained from the material which was dried in an evacuated desiccator over calcium chloride and paraffin wax. The dried samples were sealed in adsorption bulbs, and nitrogen adsorption and desorption isotherms at −195.6°C. (liquid nitrogen cold bath) were determined.

From these data, the area of each of the porous materials was computed by the B.E.T method assuming the molecular cross-sectional area of nitrogen to be 16.2 sq. A, and pore volume distributions were determined for the chlorite and KOH-extracted holocellulose employing a method described in detail by Shull (*10*). The latter determination involved replotting the experimental adsorption data to give an "inverted" isotherm. This inverted isotherm was next matched with a combination of available standard inverted isotherms*

* The terms water-dried, benzene-dried, etc., are used to indicate that the specimen was dried from the particular liquid named.

* The author wishes to acknowledge the consideration shown by Mr. Shull in making available for this work tabulated values for a number of standard inverted isotherms.

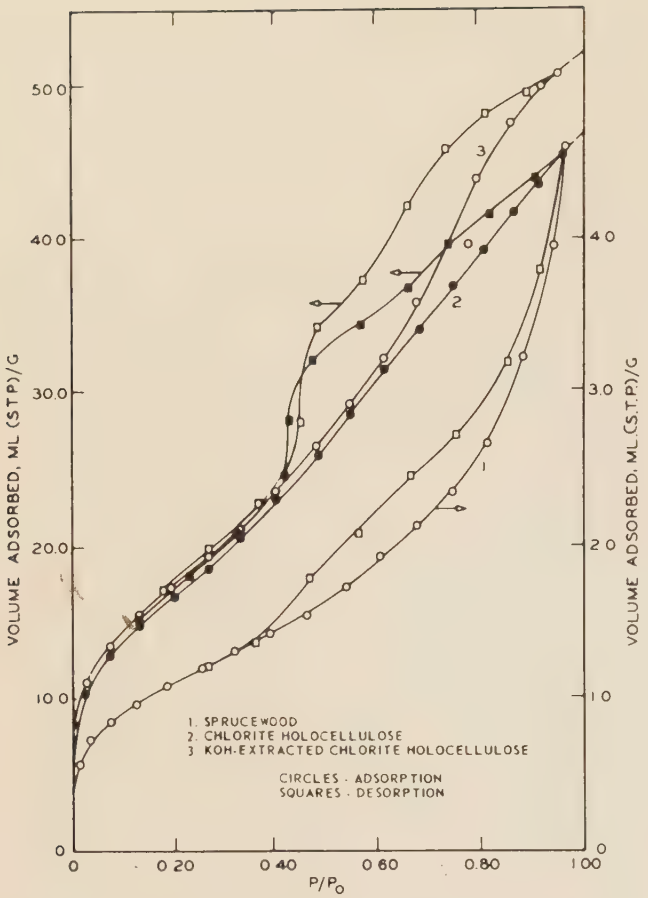

Fig. 1. Nitrogen adsorption on benzene-dried sprucewood, chlorite holocellulose, and KOH-extracted chlorite holocellulose at −195.6°C.

based on a Maxwellian distribution of pore sizes. After a satisfactory match was obtained, the pore size distribution was easily computed from the parameters of the standard isotherms.

In order to determine the effect of absorbed moisture on the accessible internal area, specimens of benzene-dried, KOH-extracted chlorite holocellulose were exposed to the various relative humidities listed in Table I until equilibrium takeup of moisture was reached.

Table I. Relative Humidities Employed in Area Studies on Benzene-Dried, KOH-extracted Chlorite Holocellulose

Solution employed	*Relative humidity at 73°F., %*
Potassium acetate saturated solution	22.9[a]
Sodium bromide saturated solution	58.5
Potassium chromate saturated solution	86.5
Ammonium monophosphate saturated solution	92.9
Sodium fluoride saturated solution	96.7[b]
1.1% Sulphuric acid solution	99.6[c]

[a] Values reported by Wink (*26*).
[b] Determination made by the Physics Department, Institute of Paper Chemistry (*27*).
[c] Determined from data given in the International Critical Tables (*28*).

Following exposure, the moisture regained by each specimen was determined. After thoroughly drying in an evacuated desiccator over phosphoric anhydride, the samples were sealed in adsorption bulbs and the B.E.T. area of each was determined.

Adsorption-Desorption Isotherms

Isotherms for the adsorption and desorption of nitrogen at −195.6°C. on benzene-dried sprucewood, chlorite holocellulose, and KOH-extracted chlorite holocellulose are given in Fig. 1. The adsorption isotherm obtained for the sprucewood dried from benzene was S-shaped and similar to that previously found for water-dried sprucewood.

However, the hysteresis loop obtained in the present study was considerably larger. The area of the sprucewood sample as measured by the B.E.T. method was 4.0 sq. m. per gram. Although soaking in water and drying from benzene after solvent displacement of the water rendered a portion of the internal area accessible to nitrogen, the effect was not nearly so great as for the samples of benzene-dried chlorite and KOH-extracted holocellulose which had areas of 61.3 and 62.2 sq. m. per gram, respectively. Because of the presence of lignin, it is possible that the sprucewood was not swollen in water to the same extent as the more purified materials and, therefore, did not possess as high an accessible internal area when dried from benzene. In addition, as has been suggested by Frey-Wyssling (*29*), a portion of the spaces between the microfibrils and the micelles in the wood may be filled with lignin.

The adsorption-desorption curves for the benzene-dried specimens of chlorite holocellulose and KOH-extracted chlorite holocelluose are not S-shaped but are examples of isotherms which have been termed type IV by Brunauer, Deming, Deming, and Teller (*30*). The peculiar shape and the large hysteresis loops of these curves are indicative of a highly porous adsorbent. The isotherms are quite similar to those obtained by Hunt, Blaine, and Rowen (*8*) for nitrogen adsorption on benzene-dried cotton linters.

Pore Volume Distributions

The pore volume distributions of the benzene-dried chlorite holocellulose and KOH-extracted chlorite

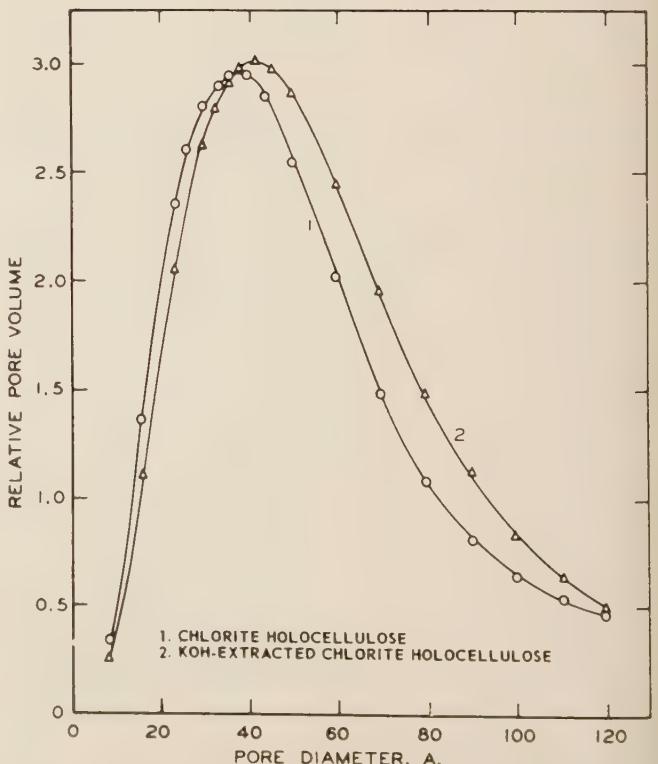

Fig. 2. Pore volume distributions for benzene-dried chlorite holocellulose and KOH-extracted chlorite holocellulose

holocellulose determined from the nitrogen adsorption data by the Wheeler-Shull method are plotted against pore diameter in Fig. 2. These volume distribution curves were adjusted so that the areas under the curves were in the same ratio as the total volumes of nitrogen adsorbed by the respective materials. It was not possible to obtain a similar distribution for the sprucewood because of the uncertainty involved in carrying out the required extrapolation to saturation pressure when the isotherm is S-shaped. Curve 1 in Fig. 2 for the benzene-dried chlorite holocellulose shows that the majority of the accessible pores have diameters between 10 and 120 A with the maximum in the distribution curve occurring at a diameter of 38 A. After extraction of the chlorite holocellulose with 5% KOH, the resulting material, when dried from benzene, had a pore volume distribution as shown by curve 2. The total volume of nitrogen adsorbed was somewhat larger and the distribution curve was shifted slightly so that the peak was increased to 42 A. It is quite likely that the alkali treatment removed soluble lignin and hemicelluloses from the cellulose structure thus enlarging the exposed pores to some extent.

The diameters at which the peaks in the volume distribution curves occur for the chlorite and KOH-extracted holocellulose agree fairly well with similar diameters of 32 and 40 A obtained by Hunt, Blaine, and Rowen for benzene-dried specimens of water- and caustic-swollen cotton, respectively. The distribution curves have, however, a somewhat greater diameter range in the present case. Using nitrogen adsorption techniques, additional information has been made available regarding the size of the submicroscopic pores and

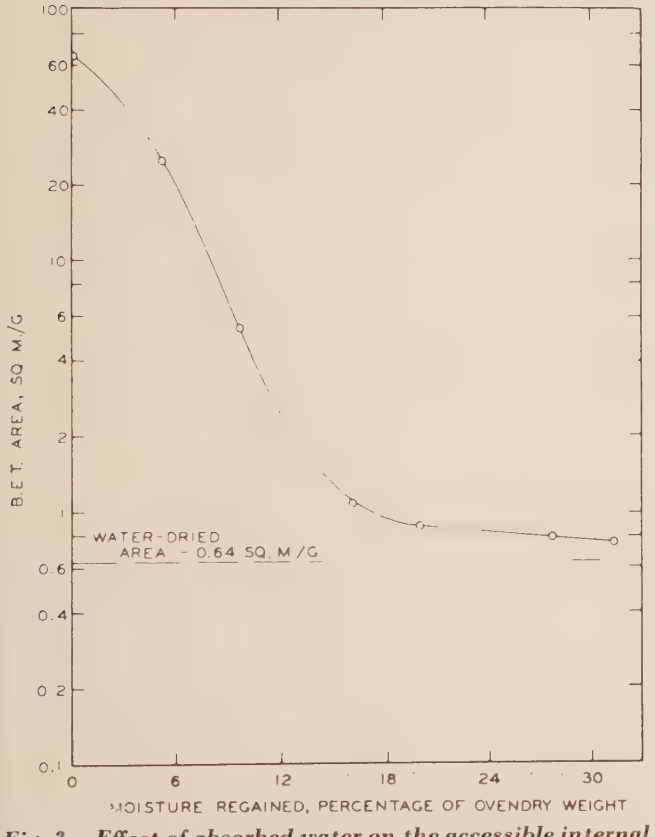

Fig. 3. Effect of absorbed water on the accessible internal area of benzene-dried, KOH-extracted chlorite holocellulose

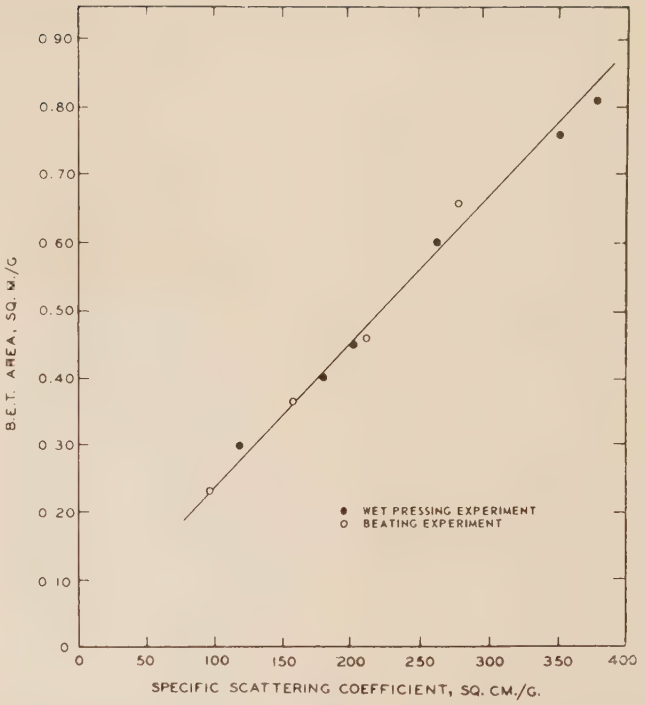

Fig. 4. Relationship between specific scattering coefficient and B.E.T. area for bleached sulphite handsheets

channels which exist between the crystallites and microfibrils of expanded wood cellulose.

EFFECT OF ABSORBED MOISTURE ON THE ACCESSIBLE INTERNAL AREA OF BENZENE-DRIED, KOH-EXTRACTED CHLORITE HOLOCELLULOSE

Benzene-dried, KOH-extracted chlorite holocellulose having an area of 67.0 sq. m. per gram was allowed to absorb various amounts of moisture and was redried. The logarithms of the B.E.T. areas of these humidified samples are plotted against the quantity of regained moisture in Fig. 3. It is observed that although the initial high internal area of the benzene-dried specimens was markedly lowered when increasing quantities of water vapor were absorbed and removed, the decrease in B.E.T. area for moisture regained above 20% was small. The original water-dried area of 0.64 sq. m. per gram was approached but the area of the humidified benzene-dried material was still 20% greater than this even after absorbing 31.5% moisture (99.6% R.H.). Since it is not probable even at 99.6% R.H. that the surface of the benzene-dried specimen ever became wet, the material is apt to have area arising from open pores and unbonded fibrils protruding from the surface which would be closed or bonded if the exterior of the particles had actually been saturated with water.

INVESTIGATION OF THE EXTERNAL SPECIFIC SURFACE OF PULPS AND THE UNBONDED AND BONDED AREA OF PULP HANDSHEETS

Preparation of Pulp and Preparation and Testing of Handsheets

For use in the work on specific surface and bonded area, bleached sulphite pulp was prepared from the same sprucewood discussed in the previous paper. A calcium-base cook was carried out in an experimental digester; the pulp was screened and bleached in three stages (chlorination, caustic extraction, and treatment with calcium hypochlorite). Pulp having a brightness

of 83% was obtained in 45% yield based on the original oven-dry wood.

Handsheets were prepared according to TAPPI Standard T 205 m from the unbeaten pulp and pulp refined for various times in a laboratory beater following TAPPI Standard T 200 m. However, a number of the unbeaten pulp sheets were pressed at pressures other than 50 p.s.i. Tensile strength determinations (15-mm. strips with 2.93 in. between clamps) were made on all regular handsheets following TAPPI Standard T 404 m. The tensile strength values were converted to pounds per inch at a basis weight of 46 lb. (25 × 40—500).

Unbonded handsheets were prepared by first forming sheets from water in a standard sheet mold and replacing the water with acetone and the acetone with butanol. A preliminary experiment was carried out in which both butanol and benzene were employed for displacement of the acetone. For unbeaten pulp, the specific scattering coefficient of the unbonded benzene-dried sheets was approximately 10% higher than for similar sheets prepared using butanol. Since the bonded area is apparently negligible in either case, it would appear that this difference in optical scattering is indicative of a difference in fiber-to-fiber bonding which does not exist, and that a spuriously high value of bonded area is apt to result when benzene is used. For this reason, it was felt that butanol was more suitable than benzene for the preparation of unbonded handsheets.

The specific scattering coefficients of all handsheets were measured at 600 mmu using a General Electric Recording Spectrophotometer in the manner discussed by Ratliff (*22*). Determinations of the nitrogen adsorption-B.E.T. area (molecular cross-sectional area of nitrogen, 16.2 sq. A) of the sheets also were carried out following the procedure discussed in the previous paper.

RELATIONSHIP BETWEEN THE SPECIFIC SCATTERING COEFFICIENT AND THE B.E.T. AREA OF BLEACHED SULPHITE HANDSHEETS

One of the basic assumptions in applying the optical method of measuring the bonded area of paper developed by Parsons (*3*) is that all of the original external surface area of the fibers in a handsheet which does not scatter light is involved in interfiber bonding. With distances of the order of 1 to 5 A associated with fiber-to-fiber bonding (optical contact can probably involve a maximum separation of 400 to 500 A), there has been some question as to the strict reliability of employing the specific scattering coefficient as a measure of the relative unbonded area. Therefore, the unbonded area of various handsheets was determined employing the B.E.T. method and this area was compared with the specific scattering coefficient measured on the same sheets.

Handsheets were prepared from unbeaten, bleached sulphite pulp having a Schopper-Riegler freeness of 865 ml. and sets of these sheets were pressed at 1, 10, 50, 150, 400, and 4000 p.s.i. Regular handsheets were also prepared from the unbeaten pulp and pulp which had been refined in a laboratory beater for 5, 12, and 24 min. to give stock having a Schopper-Riegler freeness of 830, 755, and 500 ml., respectively. The specific scattering coefficient, the B.E.T. area, and the tensile strength of each set of sheets were determined. These data are given in Table II.

Table II. Properties of Handsheets Prepared from Bleached Sulphite Pulp

S.-R. freeness of pulp, ml.	*Wet pressure, p.s.i.*	*Specific scattering coefficient, sq. cm./g.*	*B.E.T. area, sq. m./g.*	*Tensile strength, lb./in. (at 46 lb. per TAPPI ream)*
		Wet pressing experiment		
865	1	379	0.81	5.5
865	10	352	0.76	10.8
865	50	268	0.60	17.3
865	150	204	0.45	21.0
865	400	181	0.40	22.0
865	4000	118	0.30	24.0
		Beating experiment		
865	50	278	0.66	15.4
830	50	213	0.46	26.6
755	50	160	0.37	28.5
500	50	98	0.23	30.7

The B.E.T. area of the sheets is plotted against the corresponding specific scattering coefficient in Fig. 4, and it is noted that a good linear relationship exists between these two estimates of unbonded area. This correlation serves to confirm the assumption made in employing the optical bonded area method that the specific scattering coefficient of water-dried handsheets is directly related to the unbonded area regardless of whether the area has been altered by beating or by wet pressure.

AREA STUDIES ON BLEACHED SULPHITE PULPS AND PULP HANDSHEETS

An estimation of the bonded area of regular handsheets formed from unbeaten and beaten bleached sulphite pulp was initially obtained in the following three ways:

(1) The bonded area of the handsheets was determined by the optical method. This technique will only be briefly outlined since it has been discussed in detail by Ratliff (*22*). (2) The specific scattering coefficients of the water-dried and butanol-dried handsheets were determined and the silvered area of a portion of a wet pulp sheet was measured following the procedure described by Browning (*20*). (3) The value of the specific scattering coefficient of the regular handsheets was divided by the specific scattering coefficient of the butanol sheets and the ratio was multiplied by the silvered area of the pulp to give unbonded area of the water-dried handsheets. When this unbonded area was subtracted from the silvered area, an estimate of the bonded area of the regular handsheets was obtained.

From the study made of the closure of the accessible internal area of benzene-dried, KOH-extracted chlorite holocellulose by absorbed water vapor, the idea arose of using the B.E.T. area of unbonded butanol sheets humidified at 96.7% R.H. and redried as an estimate of the external specific surface of the pulp. Since the water-dried area of the KOH-extracted chlorite holocellulose was not reattained when a benzene-dried specimen was allowed to absorb over 30% moisture and was redried, it is not likely that the closure of the internal area of the butanol-dried sheets will be complete. If this is the case, when the B.E.T. area of the humidified butanol sheets is measured, all of the external surface of the fibers will be determined and, in addition, a small but unknown portion of the internal

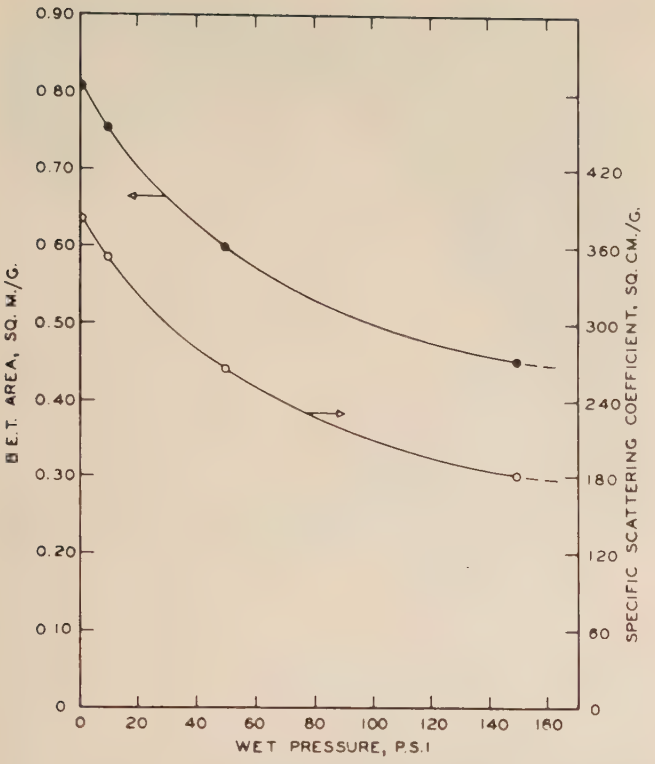

Fig. 5. Effect of wet pressing on the specific scattering coefficient and the B.E.T. area of handsheets prepared from unbeaten bleached sulphite pulp

area. The estimated bonded area resulting from the difference in the B.E.T. area of the humidified butanol sheets and the regular handsheets will be equal to or larger than the true bonded area and, for this reason, was termed the "maximum" bonded area.

An estimation of bonded area was also obtained from the difference in the B.E.T. area of the regular handsheets and the similar area of the constituent pulp fibers which had been spray dried in an attempt to minimize fiber-to-fiber bonding. Briefly, the drying procedure involved spraying a 0.20% consistency pulp slurry onto a horizontal sheet of polythene so that approximately 0.8 gram of fibers was spread over 55 sq. ft. and contact between fibers was at a minimum. When the fibers were dry, they were brushed from the polythene with a lint-free cloth and removed with a vacuum collector. If fines are not lost in handling and if the bonding between fibers is not appreciable, the difference in the B.E.T. areas of the spray-dried fibers and the regular handsheets should provide a good estimate of the bonded area of the handsheets. Actually, some loss of fines and some bonding does occur, at least for the beaten pulps. Then the nitrogen adsorption area of the spray-dried pulp, when in error, will be lower than the true external specific surface of the dried fibers. It follows that the actual bonded area of the handsheets will be equal to or higher than the bonded area determined in this way. Therefore, the difference in the B.E.T. areas of the spray-dried pulp and the respective pulp handsheets has been termed the "minimum" bonded area.

Table III gives the silvered and B.E.T. areas of the pulps and the specific scattering coefficients and the B.E.T. areas of the pulp sheets together with estimates of optical, "minimum," and "maximum" bonded areas. Although most of the area and scattering measurements changed in the expected manner when the pulp was beaten, the B.E.T. area of the spray-dried pulps and of the humidified butanol sheets was essentially unaltered until the pulp had been refined to an appreciable extent. The behavior of the area of the humidified butanol sheets suggests that the beating action may condition the gross internal structure of the pulp in such a way that it is more readily closed when absorbed moisture is removed, thus counterbalancing, for a time, the increase in external specific surface which also occurs. However, the high areas of all of the humidified butanol sheets indicate that a considerable amount of internal area was being measured. It is felt that the irregular area values obtained for the spray-dried pulps on beating were due to the occurrence of some interfiber bonding and loss of fines when the beaten pulps were dried. The low B.E.T. areas of the

Table III. Optical and B.E.T. Area Measurements on the Various Pulps and Handsheets

	Beating time, min.			
	0	*5*	*12*	*24*
S.-R. freeness, cc.	865	830	755	500
Silvered area, sq. m./g. A	1.26	1.64	2.13	2.57
Specific scattering coefficient, sq. cm./g.				
Water-dried handsheets B	278	213	160	98
Butanol-dried sheets C	565	578	637	752
B.E.T. area, sq. m./g.				
Water-dried handsheets D	0.66	0.46	0.37	0.23
Butanol-dried sheets after exposure to 96.7% R.H. E	2.34	2.31	2.33	2.75
Spray-dried pulp F	0.81	0.78	0.82	1.05
Bonded area, sq. m./g.				
Optical (C-B/C)A	0.64	1.04	1.59	2.24
"Maximum" (E-D)	1.68	1.85	1.96	2.52
"Minimum" (F-D)	0.15	0.32	0.45	0.82

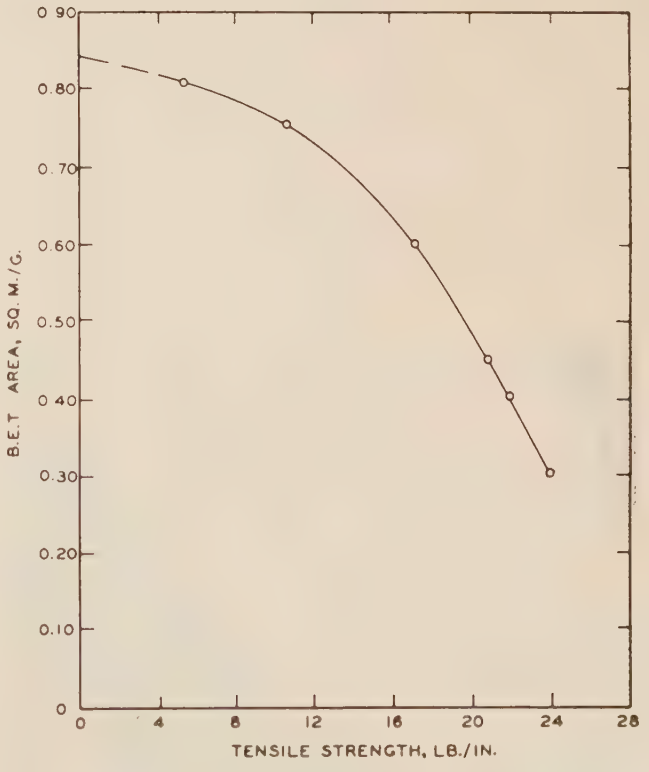

Fig. 6. Relationship between tensile strength and B.E.T. area for handsheets prepared from unbeaten bleached sulphite pulp

Table IV. External Specific Surface of Dry Unbeaten Sulphite Pulp as Estimated by Different Procedures

Procedure employed in obtaining estimate	*Estimated external specific surface of dry fibers, sq. m./g.*
B.E.T. area of spray-dried fibers	0.81
Extrapolation of B.E.T. area-wet pressure plot (Fig. 5) to zero pressure	0.82
Extrapolation of specific scattering coefficient-wet pressure plot (Fig. 5) to zero pressure and use of Fig. 4 to estimate B.E.T. area	0.85
Extrapolation of tensile strength-B.E.T. area plot (Fig. 6) to zero tensile strength	0.84

spray-dried pulp in comparison to the silvered areas, and the values obtained for bonded area by all methods will be subsequently discussed.

In order to determine if the area of 0.81 sq. m. per gram obtained for the spray-dried unbeaten pulp appears to be close to the actual dry external specific surface, this area was estimated in several other ways. A plot of the B.E.T. areas and the specific scattering coefficients of unbeaten pulp handsheets pressed at 1, 10, 50, and 150 p.s.i. (see Table II) against wet pressure is given in Fig. 5. The curve for the B.E.T. area was extrapolated to zero pressure and the estimated external specific surface was read directly. For the specific scattering coefficient, the plot was similarly extrapolated to zero pressure to give 384 sq. cm. per gram and the area corresponding to this value was determined from Fig. 4. These results appear in Table IV. The other technique employed to estimate the dry specific surface of the unbeaten pulp involved plotting the B.E.T. areas against the tensile strength values given in Table II for unbeaten pulp handsheets pressed at 1, 10, 50, 150, 400, and 4000 p.s.i. This plot is given in Fig. 6. The area obtained on extrapolation to zero tensile strength is also included in Table IV. The specific surface estimates by all four methods are quite similar, and it is felt that this constitutes valuable evidence that the external specific surface of the dry unbeaten pulp which was studied is close to 0.81 to 0.85 sq. m. per gram.

Even if a value of 0.84 sq. m. per gram is taken as the dry specific surface of the unbeaten pulp, it is still considerably lower than the observed silvered area of 1.26

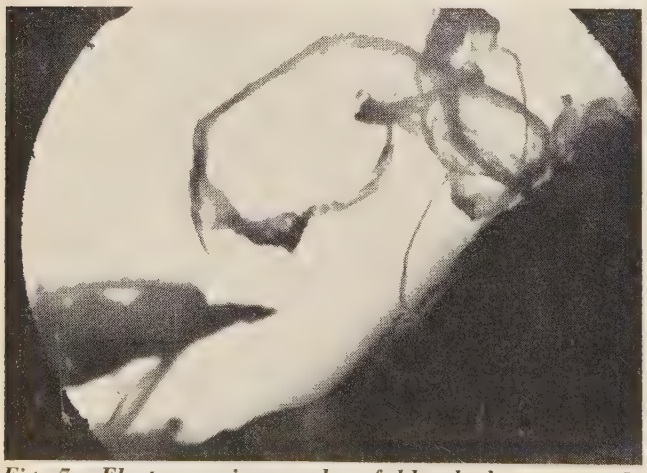

Fig. 7. Electron micrographs of bleached spruce pulp beaten for 5 min. and aluminum shadowed at 90°

Fig. 8. Electron micrographs of bleached spruce pulp beaten for 5 min. and aluminum shadowed at 90°

sq. m. per gram. Also the estimated value of 384 sq. cm. per gram for the specific scattering coefficient of the unbonded water-dried pulp obtained from Fig. 5 is markedly lower than the specific scattering coefficient of 565 sq. cm. per gram obtained for butanol-dried sheets of the same unbeaten pulp. The ratio of the estimated dry specific surface to the silvered area and of the estimated specific scattering coefficient of the unbonded water-dried fibers to that for the butanol sheets is 0.67 and 0.68, respectively. This agrees quite well with the findings of Leech (*25*) that the ratio of the specific scattering coefficient of water-dried unbonded sulphite pulp fibers to that for similar benzene-dried unbonded fibers was 0.59. It is believed that this similarity of ratios is not coincidence but rather is an indication of the nature of the surface and structure of the wet, water-dried, and butanol-dried fibers.

When pulp is suspended in water, the fibers are swollen, the surface of the fibers probably contains some large exposed pores, and the surface fibrils and fuzz described by Clark (*31*), when present, will be in an unbonded extended condition. When this wet pulp is dried, surface tension and bonding forces will most likely act to shrink the fibers, close up the accessible pores, and collapse and bond many of the surface fibrils to the surface of the parent fiber. If, on the other hand, the water is replaced and the fibers are dried from butanol, it is reasonable to believe that only a slight shrinkage of the fibers would occur, the larger surface pores would not be closed, and the surface fibrils would largely remain in an erect unbonded condition capable of pronounced light scattering. In other words, when either wet with water or dried from butanol, the pulp fibers are apt to be in much the same condition since they would probably have a high "swollen" area and unbonded exposed surface fibrils, whereas the fibers dried from water would not.

Slightly-beaten unbonded sulphite pulp fibers, both dried from butanol and spray-dried from water, were shadowed with aluminum and inspected with an electron microscope. Electron micrographs of typical observations are given in Figs. 7 and 8. The surface of the butanol-dried fibers was, in some areas, fairly smooth but very frequently pronounced surface fibrillation of

the type shown was observed. The surface of the water-dried fibers, however, was almost entirely free of projecting fibrils and most often had the appearance depicted in Figs. 7 and 8. It should especially be noted that not only is a gross fibrillation apparent on the surface of the butanol-dried fibers, but also a very fine fuzz (see upper portion of the micrograph) can be detected. Whereas surface porosity and over-all shrinkage effects are certainly influential in causing the differences in the optical scattering exhibited by the water-dried and butanol-dried unbonded fibers, it was concluded that the observed divergencies in surface characteristics must also contribute to a substantial extent.

It seems incorrect, therefore, to take the entire difference in the specific scattering coefficients of the butanol sheets and the regular handsheets as being due to differences in bonded area. Since the optical method does just this, the area values obtained with the method may be considerably higher, in some cases, than the true bonded area. A method of empirically correcting the specific scattering coefficients of the butanol sheets suggests itself on the grounds that such a procedure would seem to permit more accurate estimates of bonded area. For the unbeaten sulphite pulp employed in the present work, the correction factor has been shown to be approximately 0.67, although it is reasonable to believe that for other pulps it could approach unity. The factor of 0.67 was assumed to hold for the beaten pulps, and percentage bonded areas were estimated with this modified optical technique. [If estimates of numerical bonded area are desired, they can be obtained from a linear plot of B.E.T. area against specific scattering coefficient (see Fig. 4).]

Table V gives estimates of percentage bonded areas obtained by the regular optical method in which the specific scattering coefficients of the butanol sheets were multiplied by a constant fractional correction factor and by the "minimum" and "maximum" techniques previously discussed. Since the internal fiber area accessible to nitrogen is not completely closed when the butanol sheets are exposed to 96.7% R.H. and then redried, the values determined by the "maximum" method are quite high and do not appear to constitute useful estimates of bonded area. Although the spray-dried beaten pulps are apparently bonded to some extent, causing the percentage bonded areas determined by the "minimum" method to be slightly low, it is felt that this spray drying-B.E.T. area technique provides a fairly good estimate of bonded area.

The percentage bonded areas estimated by the regular optical method are seen to vary from 51% for the unbeaten pulp handsheets to 87% for sheets prepared from pulp beaten for 24 minutes. This high value of 51% of the total surface area of unbeaten pulp fibers apparently bonded is not believed to represent the true situation. Most likely, this apparently high value results from the optical scattering differences of unbonded water-dried and butanol-dried fibers already discussed.

When the scattering measurements on the butanol sheets were corrected in the manner outlined, percentage bonded areas were obtained which were considerably lower than the regular optical values. These "corrected" optical areas paralleled quite well the "minimum" areas determined by the spray drying B.E.T. area method. From the results obtained, it is believed that the use of suitably corrected values of the specific scattering coefficients measured on the butanol sheets provides a method of estimating the bonded area of regular pulp handsheets which gives values closer to the true bonded area of these sheets than can be determined by the optical method as it has been commonly employed.

Table V. Percentage Bonded Areas as Estimated in Various Ways

	Beating time, min. 0	5	12	24
Regular optical method, %	51	63	75	87
Optical method employing corrected scattering coefficients of butanol sheets, %	26	45	63	81
Employing B.E.T. areas of spray-dried pulps and regular handsheets; "minimum," %	19	41	55	78
Employing B.E.T. areas of humidified butanol sheets and regular handsheets; "maximum," %	72	80	84	92

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Optical Measurement of Bond Breaking During a Tensile Test

LARS NORDMAN, CHARLEY GUSTAFSSON, AND GÖRAN OLOFSSON

The hypothesis that bonds are broken in a strip of paper subjected to straining at prerupture loads has been tested by optical methods. Light scattering occurs only from the so-called free surface area of the paper. If bonds are broken in a tensile test this would lead to an increase in the free surface area of the paper and thus to an increase in light scattering. This has been verified in a series of tests where paper strips have been strained directly over the aperture of a sensitive reflection meter. Graphs representing different straining cycles are shown and from these curves it is evident that bonds are broken during the straining cycles and that the breaking of bonds is an irreversible process. In relaxation tests it has been found that time is a factor in the bond breaking. The rate of breaking of bonds differs in different parts of the test strip indicating the importance of stress distribution. In quantitative tests it has been found that the breaking of bonds is related to the amount of energy consumed in the straining cycle. The experimental evidence gathered supports the hypothesis that microbreaks occur all over the test strip already at prerupture loads.

In a paper by Van den Akker (*1*), an account is given of his investigations to detect the sounds generated in a paper subjected to strain. He connected the paper strip to a microphone and amplifier, but was only able to hear a few weak pipsounds just before a loud pop announced that the strip had failed. The present investigation is not an acoustical but an optical approach to the problem of what happens when a strip of paper is subjected to strain.

The Kubelka-Munk theory is an excellent tool by means of which the optical properties of light-scattering materials such as paper can be treated. By determining two independent reflectance values of a paper, e.g., the reflectance with black backing and the reflectance with a standard backing, the specific scattering coefficient of the paper can be calculated. The specific scattering coefficient is expressed in square centimeters per gram and has been used, e.g., by Parsons (*2*) and Ratliff (*3*) as a relative measurement of surface area per weight of paper. Light scattering occurs only from boundaries between media of different refractive indices. Light will thus be scattered from the boundaries between air and fibers but not from a fiber-fiber boundary.

The strength of a paper structure is generally attributed to the existence of fiber to fiber bonds. Part of the surface area of the fibers will thus be in mechanical contact with other fiber surfaces in the paper, and it is generally believed that the area of mechanical contact is equivalent to the area of optical contact. There is therefore no scattering from the bonded area of a paper; only the free surface area of the paper will scatter light.

To test the hypothesis that bonds are broken in a loaded paper already at prerupture stresses the scattering from the paper can be measured. If bonds are broken the area of mechanical contact will be decreased to an extent that exactly corresponds to the increase in the free surface area of the paper, and this in turn can be readily measured as outlined above. The increase in the scattering coefficient of the paper is thus a relative measurement of the amount of bonds that have been broken in the loading process up to the time of the reflectance determination. If the optical measurements are performed continuously during the loading a record can be obtained showing the extent of breaking of bonds as a function of either the load applied, the strain, or the time. For this purpose an instrument was built consisting of a sensitive reflection meter and a straining device, Fig. 1. By means of this instrument a paper strip clamped over the aperture of the optical instrument can be stretched at a constant rate of strain. The long side of the 2 by 14 mm. aperture is perpendicular to the direction of straining.

As long as we are interested in a qualitative analysis only of the breaking of bonds, one reflectance value, R_o, is measured. This value will give a sufficiently accurate estimate of the increase in the scattering coefficient of the paper strip. If quantitative measurements are required two reflectance values must of course be determined.

Figure 2 is a record obtained for a strip of a laboratory-made sheet. Since the rate of straining is constant the chart movement is proportional to the strain. In this example the strip was strained to point a, where the direction of straining was reversed. From a to b the strip was allowed to contract and at point b a new straining cycle was started. From b the strip was strained to rupture. For the sake of surveyability the graphs have been replotted so as to give the change in reflectance as a function of the positive strain, Fig. 3. In this way the diagrams can be easily compared with stress-strain curves of paper. It can be seen that the scattering starts to increase only after the strip has been strained to a certain degree. This point up to which no breaking of bonds can be detected corresponds roughly to the end point of the seemingly elastic portion of the stress strain curve.

Sometimes wavy curves have been recorded, as in Fig. 4. We considered the variability in the slope of the curve significant, for the following reasons. Weak points are distributed all over the test strip. These

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weak points break successively during draining when the local stresses exceed the breaking strength of the points in question. When at a given moment the weakest point in this respect is located over the aperture of

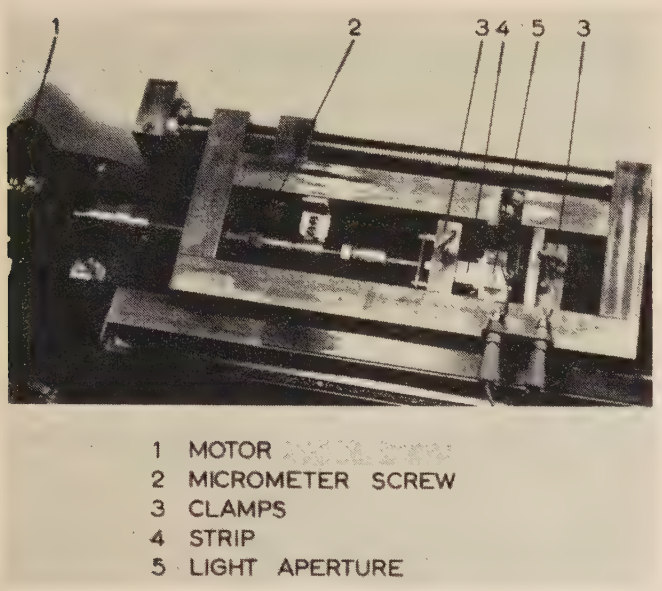

Fig. 1. Reflection meter with straining device

the optical instrument a sharp rise in the reflection curve can be observed indicating a momentarily increased rate of bond breaking. Curves of this type have been recorded especially for papers with a wild formation.

An analysis of the breaking of bonds when a paper strip is strained in several cycles reveals certain interesting information. Referring to Fig. 5, it is found that when the direction of straining is reversed, in other words when the test strip starts to contract, there is a very slow decrease in reflectances which continues until the cycle is completed. The strip is then unloaded but has suffered a permanent strain. At the same time there is an irreversible increase in reflectance or scattering which indicates that a number of bonds have been broken during the straining cycle. The

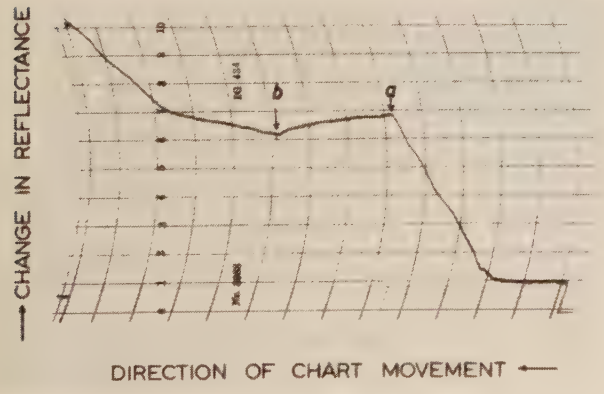

Fig. 2. Reflectance recording obtained during a straining test

slow decrease in scattering during destraining can be explained by assuming either that there is a slow reformation of fiber bonds or that fractures caused by the straining shrink to dimensions smaller than those still causing light scattering. The irreversible breaking of bonds, however, is permanent within the limits determined by the stability of the optical instrument.

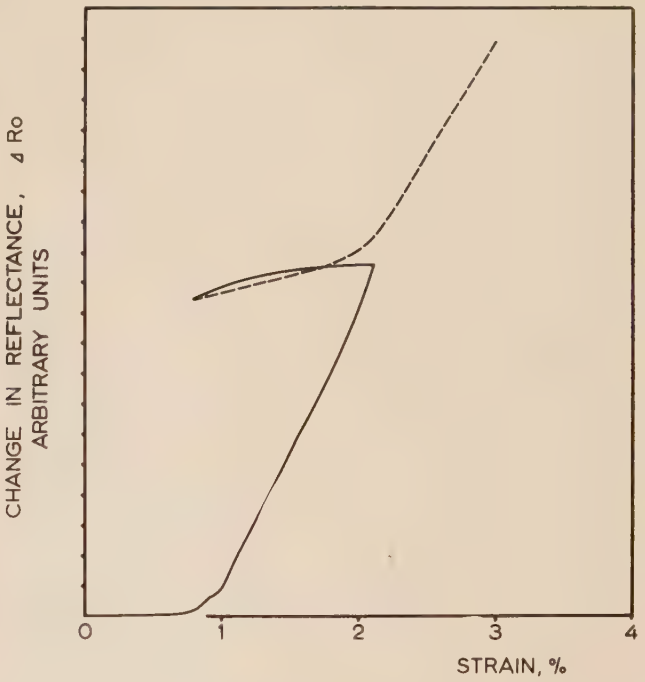

Fig. 3. Replotted reflectance recording

A new straining cycle to the same maximum strain as in the first cycle causes a new increase in light scattering, indicating that a number of bonds has again been broken. From the relative magnitudes of the reflectance values it can however be deduced that the breaking of bonds in the second cycle occurs to a lesser degree than in the first cycle. If the third straining cycle is extended beyond the maximum strain in the first two cycles there is again a rapid rise in the reflectance curve, which is a sign that the bonds in the paper structure are broken at an increased rate. The breaking of bonds is thus influenced partly by the magnitude of the straining cycle and partly by the prehistory of the test sample. A third factor seems to be the rate of straining. It has been found that at a slow

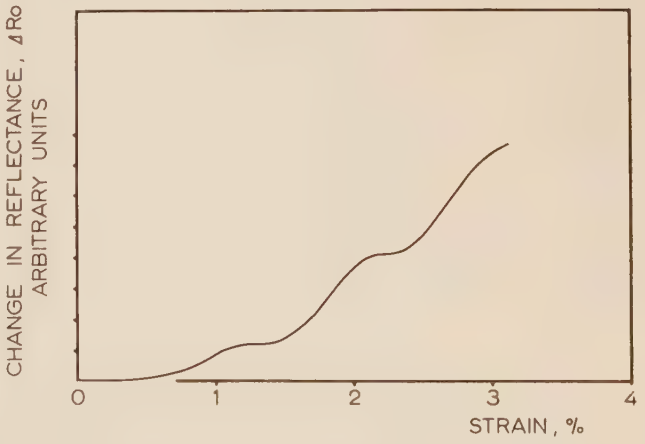

Fig. 4. Recording obtained for a paper with a wild formation

rate of straining, even after the direction of straining has been reversed, there is a gradual increase in scattering. This appears to indicate that bonds continue

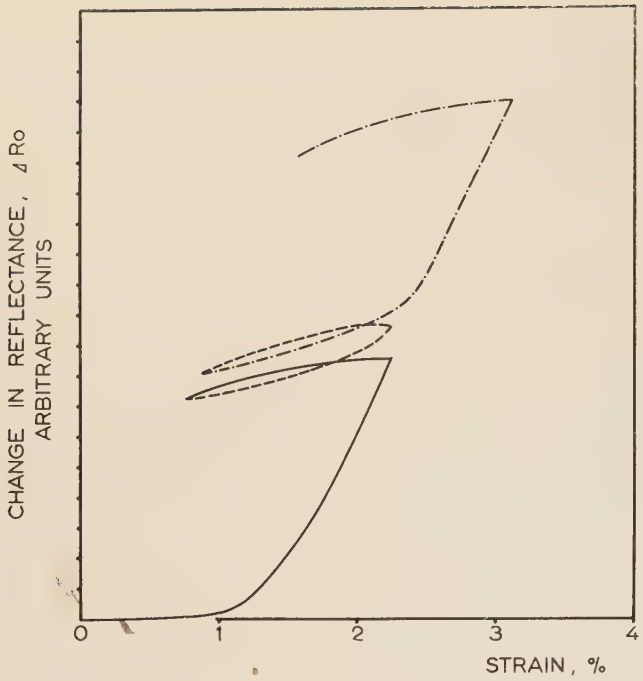

Fig. 5. Reflectance curve for a paper strained in three cycles

to break even if the stress is relieved, although at a slower rate. This observation was logically explained when it was found that bonds broke also during stress relaxation. A record of a relaxation test is given in Fig. 6. After the strip was strained to a given strain the straining motor was disengaged and the strip was allowed to relax at a constant length. The vertical line in the diagram thus represents the breaking of bonds that occurred during the relaxation period. The strip was then allowed to contract, and it can be observed that the decrease in scattering is smaller than the increase during relaxation; the irreversible breaking of bonds is therefore larger than it would have been had the straining cycle been performed in sequence.

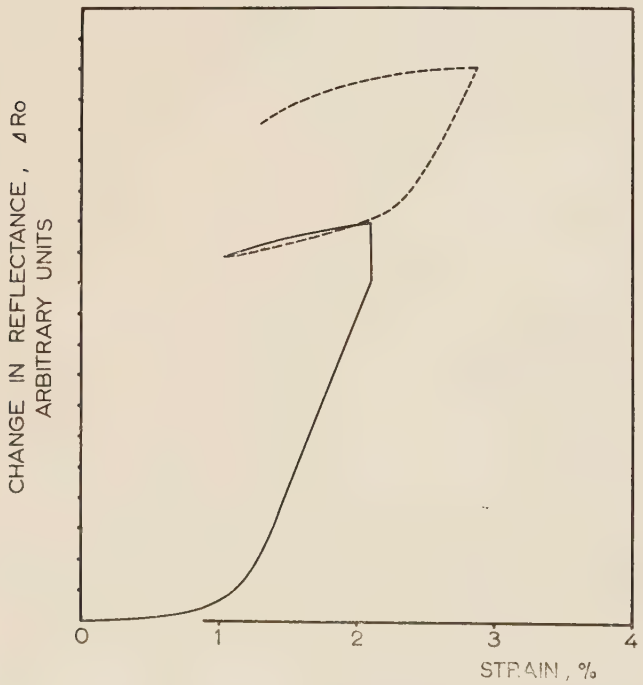

Fig. 6. Reflectance curve for a paper strained in two cycles with an intermediate relaxation step

The breaking of bonds during relaxation as a function of time is shown in Fig. 7. The nature of the curve is similar to that of the well known stress relaxation curve of paper in that the changes are very rapid in the beginning and then level out.

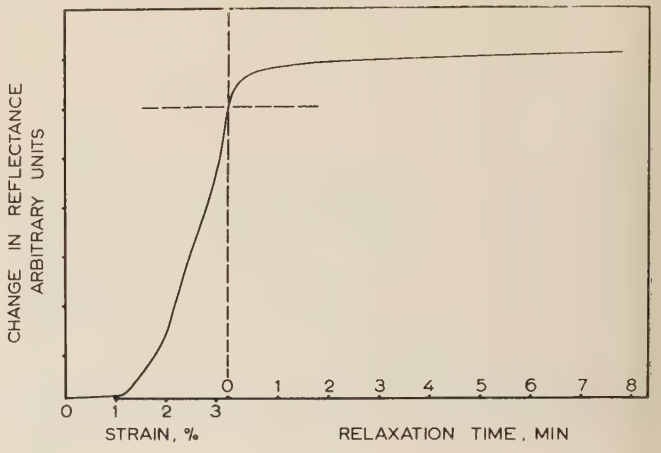

Fig. 7. Reflectance curve showing relationship between increase in scattering and relaxation time

Some fairly interesting curves have been obtained when strips have been strained to rupture and care has been taken to ensure that the zone of failure coincides with the aperture of the reflectance instrument, Fig. 8. This can be done by cutting the edge of the test strip at the appropriate location. A very pronounced increase in scattering then occurs at the moment of failure, which is explained by the fact that in this zone a large number of bonds must be broken before the fibers are completely disengaged. It is probable that the increase in scattering could be still larger but, due to the loosening of the paper structure, part of the light passes straight through interstices between fibers and, thus, does not contribute to the scattering.

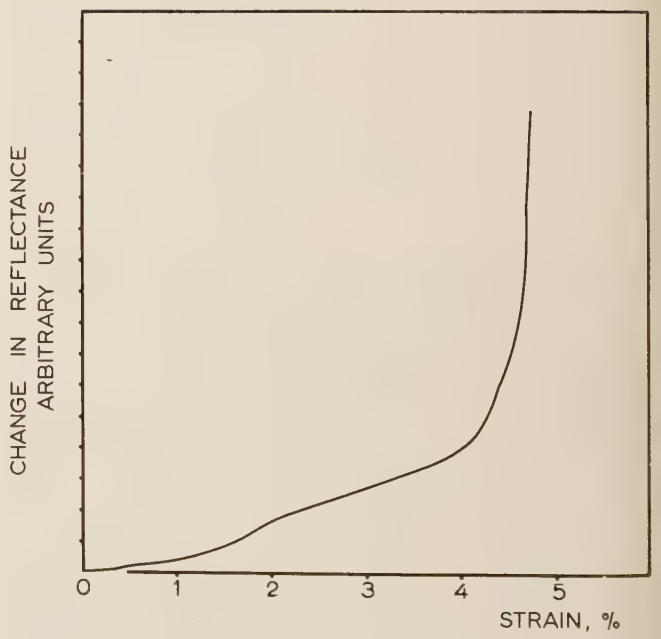

Fig. 8. Reflectance curve obtained for the zone of rupture

In all the tests described so far a comparatively small area of the test strip has been under observation. It would therefore be interesting to note the changes in reflectance throughout the entire length of the test strip. For this purpose a test strip was mounted in a carriage which was run at constant speed over the aperture of the optical instrument.

This gave a continuous record of the reflectance with black backing of the whole virgin test strip. The test strip was then detached from the carriage, inserted in a stress-strain instrument, and subjected to a loading-deloading cycle. As will be remembered, the scattering increases irreversibly after such a cycle. The test strip was again transferred to the optical instrument and a second reflectance record was run. When the two diagrams were superimposed the changes in reflectance along the strip were visualized, Fig. 9.

The waviness of the curves is of course due to the "cloudiness" of the paper, that is to local basis weight and density variations. It can be seen that the loading cycle increases the scattering over the whole length of the test strip. It is interesting, however, to note that the increase seems to be greatest in the parts of the strip that had the lowest reflectance-values before loading. These areas are either thinner parts or otherwise optically less scattering parts of the strip. Of these two alternatives the former seems to be more plausible, and the more extensive breaking of bonds could, thus, be related to the presence of local areas with a lower basis weight and consequently a less favorable stress distribution.

From these qualitative investigations it is evident that long before it is finally ruptured in a tensile test small microbreaks occur all over the test strip. The microbreaks are located in areas where the stress distribution is unfavorable either due to deficiencies in the paper structure or to a redistribution of stresses caused by preceding microbreaks in certain locations. Each microbreak involves the removal from one another of two points, or rather two microsurfaces, to a distance over which the forces of attraction can no longer act.

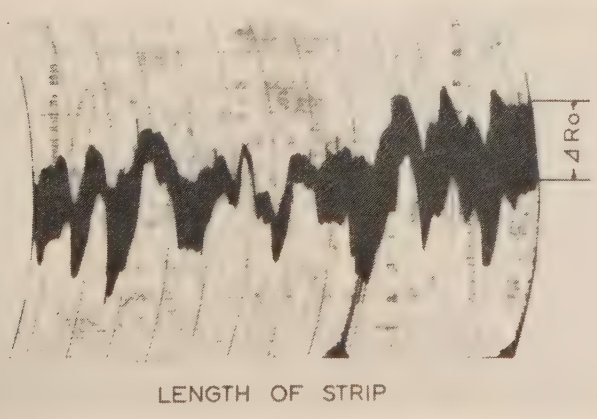

Fig. 9. Reflectance curves measured along a test strip before (lower curve) and after (upper curve) the test strip was subjected to a loading-deloading cycle. The black area, thus, represents the increase in scattering

A certain energy is thus consumed in the breaking process, and at the same time the surface elements are displaced so as to be able to scatter light. It is not surprising therefore that in a quantitative investigation carried out, the results of which have been published elsewhere (*4*), a linear relationship could be established

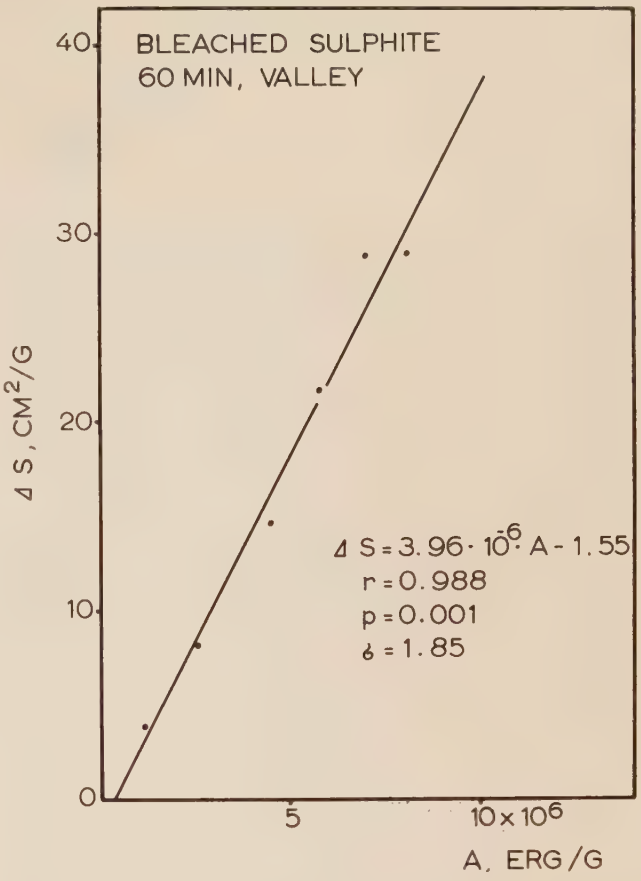

Fig. 10. Quantitative relationship between increase in scattering and energy consumed in loading-deloading cycles

between the over-all increase in the scattering coefficient and the amount of energy irreversibly consumed in a loading cycle, Fig. 10.

The mechanical aspects of the prerupture behavior of paper has been the subject of diverse opinions. Based on the observation that the thickness of a paper is increased after the paper has been loaded and deloaded, Rance puts forward the opinion that the breaking process consists of a series of microbreaks that occur at an ever-increasing rate (*5*). The experimental evidence of the formation of new free surfaces in a paper during loading, obtained in the present investigation, confirms this opinion. Prerupture microbreaks occurring all over a sample of paper subjected to strength testing must therefore be considered a reality. This concept will undoubtedly add to our ability to treat problems relating to the mechanical strength of paper.

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Presented at the Fifth Testing Conference of the Technical Association of the Pulp and Paper Industry, Dayton, Ohio, Oct. 8, 1954.

Aqueous Hydrolysis of Lignin

I. Paper Chromatographic Separation of Monomeric Lignin Degradation Products

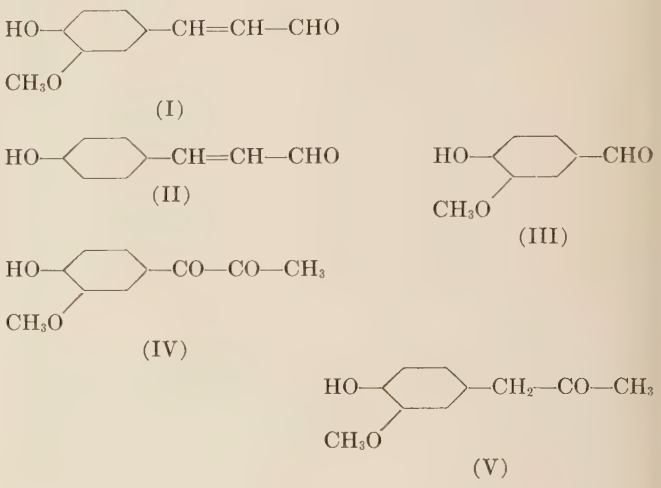
OTTO GOLDSCHMID

A method for the paper chromatographic separation of monomeric lignin degradation products is described which employs both the organic and aqueous phases of Lindstedt's mixture of benzene, ligroin, methanol, and water as the mobile phase. The new method was applied to the ether-soluble hydrolysis products formed on treatment of extractive-free western hemlock wood and Brauns' hemlock native lignin with water at 175°C. Monomeric lignin degradation products separated and identified included, in addition to vanillin, coniferylaldehyde, obtained in much larger yield than the other degradation products, vanilloyl methyl ketone and guaiacyl acetone, well-known from the work of Hibbert as ethanolysis products of wood, and *p*-coumaraldehyde which has not been isolated from lignin previously. Repetition of the hydrolysis after exhaustive extraction of the hydrolyzed wood yielded additional amounts of the same lignin degradation products. Moreover, the extracted, hydrolyzed wood still gave an intense color reaction with phloroglucinol. In addition to the ether-soluble monomeric lignin degradation products, an ethanol-soluble lignin fraction was formed in the hydrolysis. This fraction gave an intense color reaction with phloroglucinol and an ultraviolet absorption spectrum indicating the presence of considerable side-chain conjugation in this fraction. From similar hydrolyses of Brauns' native lignin, the same lignin degradation products were obtained as in the case of the wood. The yield of coniferylaldehyde in the combined ether extracts from two successive hydrolyses was estimated to represent 3 to 4% of the native lignin. The possibility that coniferylaldehyde groups are formed in the hydrolysis reaction is briefly discussed.

Of the various cleavage reactions used to study the chemical structure of lignin, perhaps the mildest is aqueous hydrolysis at elevated temperature. This technique has been used by several investigators in the past, but with only indifferent success (*1*). The principal difficulty has been the separation of identifiable compounds. The advent of paper chromatography has provided an elegant procedure for isolating and identifying compounds not otherwise separable. In the present work, this technique was applied to the products obtained by aqueous hydrolysis of western hemlock wood and of Brauns' native lignin isolated from western hemlock wood.

RESULTS

By means of the chromatographic method described below, it has been found that treatment of solvent-extracted hemlock wood with water at 175°C. results in the formation of coniferylaldehyde (I), *p*-coumaraldehyde (II), vanillin (III), vanilloyl methyl ketone (IV), guaiacyl acetone (V), and several other as yet unidentified compounds, which are derived from the lignin, in addition to the formation of sugars, furfural, and 5-hydroxymethylfurfural, which are evidently derived from the carbohydrate constituents of the wood. Coniferylaldehyde is obtained in much larger yield than the other lignin degradation products (Fig. 1).



After removal of the degradation products by exhaustive extraction of the hydrolyzed wood, a repetition of the hydrolysis yields additional amounts of coniferylaldehyde, *p*-coumaraldehyde, and the other lignin cleavage products. Moreover, the lignin remaining in the wood after the hydrolysis and extraction still appears to give at least as intense a color reaction with phloroglucinol as the original wood.

In addition to the splitting off of monomeric units from the lignin macromolecule, some cleavage of the lignin to form smaller lignin molecules also apparently occurs, as shown by the formation of an ethanol-soluble "hydrolysis lignin." The ultraviolet absorption spectrum (Fig. 2) of this fraction, which gives a strong color reaction with phloroglucinol, indicates that the "hydrolysis lignin" contains considerably more side-chain conjugation than Brauns' native lignin.

When Brauns' native lignin is hydrolyzed under identical conditions, the same cleavage products are obtained as in the case of the wood. Additional amounts of the same products are formed when the hydrolysis is repeated. In two successive hydrolyses, a combined yield of coniferylaldehyde estimated to represent 3 to 4% of the original native lignin has been obtained.

DISCUSSION

There has been considerable speculation and debate

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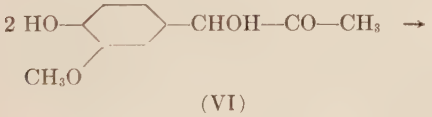
as to the chemical structure of the lignin monomeric unit. The isolation of cleavage products from lignin by a mild process should contribute to the knowledge of this structure even if the cleavage products represent a small fraction of the lignin only.

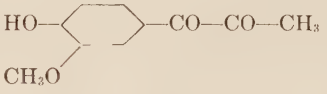
Adler (*2*, *3*) suggested in 1948 that lignin contains a small number of coniferylaldehyde groups (about one in 40 phenylpropane units) probably as end groups. This suggestion was based on a study of color reactions of lignin. This work was later confirmed by Pew (*4*). Adler (*3*) also isolated coniferylaldehyde in very small yield from extractive-free sprucewood by the "Hadromal" procedure. There is no evidence at present to indicate that any appreciable number of double bonds exists in lignin *in situ* (*5*).

The isolation from lignin of *p*-coumaraldehyde, which does not seem to have been reported previously, is in excellent agreement with the result of Leopold (*6*) who found that in the alkaline nitrobenzene oxidation of western hemlock wood, small amounts of *p*-hydroxybenzaldehyde are formed in addition to vanillin; *p*-hydroxybenzaldehyde bears the same relationship to *p*-coumaraldehyde (II) as vanillin (III) does to coniferylaldehyde (I).

Vanilloyl methyl ketone (IV) and guaiacyl acetone (V) were first isolated by Hibbert (*7*) from the products of the ethanolysis of wood. Hibbert (*8*) demonstrated that these compounds are formed, under conditions similar to the ethanolysis of wood, from two molecules of 1-hydroxy-1-(3-methoxy-4-hydroxyphenyl)-2-propanone by a disproportionation-dehydration mechanism:

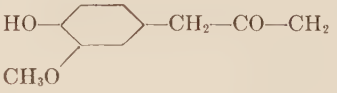


(VI)



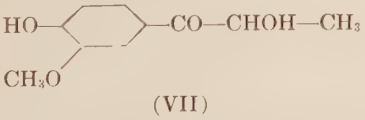
(IV)

$+H_2O$



(V)

While the latter compound (VI) has not yet been identified positively, there is some evidence (see experimental part) that it is present among the products of the aqueous hydrolysis. On the other hand, α-hydroxypropiovanillone (VII), the 2-ethoxy ether of which is the principal product of the ethanolysis treatment of VI (*8*), appears to be absent from the products of the aqueous hydrolysis.



(VII)

The strong color reaction with phloroglucinol of the exhaustively extracted hydrolyzed wood, and the liberation of additional amounts of coniferylaldehyde when the hydrolysis is repeated, indicate that coniferylaldehyde groups are present in the hydrolyzed wood. This result suggests the possibility that new coniferylaldehyde groups may form in the hydrolysis reaction which are then liberated by a repeated hydrolysis. Conceivably, such a formation of coniferylaldehyde groups could occur under the conditions of the hydrolysis by an acrolein-type dehydration of guaiacyl glycerol units. Adler has recently shown that veratryl glycerol (*9*) and its β-guaiacyl ether (*10*) are excellent models for certain reactions of lignin such as sulphonation and ethanolysis, and Freudenberg (*11*) very recently identified one of the dimers formed as an intermediate in the enzymatic dehydrogenation of coniferyl alcohol as the β-coniferyl ether of guaiacyl glycerol.

The possibility that new double bonds are formed in the hydrolysis reaction is suggested also by the strong color reaction with phloroglucinol of the ethanol-soluble "hydrolysis lignin" and by its ultraviolet absorption spectrum (Fig. 2). The marked shoulder in the 330 mmu region (curve 1), and especially the absorption maximum at 370 mmu of the difference curve (*12*, *13*, *14*) between the alkaline and the neutral solution (curve 2), indicate the presence in this fraction of an appreciable number of conjugated double bonds or carbonyl groups in the side chain.

In order to determine whether the formation of additional coniferylaldehyde groups, suggested by these results, actually occurs in the hydrolysis reaction, quantitative estimates of the amounts of coniferylaldehyde present in the original wood, and liberated by the hydrolysis, are required. The development of methods for the quantitative determination of coniferylaldehyde, and the application of the hydrolysis reaction to other woods and isolated lignin preparations, are in progress.

EXPERIMENTAL

Hydrolysis of Wood

Alcohol-benzene extracted western hemlock wood meal (*Tsuga heterophylla*, 40 to 80 mesh) was suspended in 10 times its weight of water and heated in a small autoclave for 45 min. at 175°C. After cooling, the mixture was filtered and the wood meal washed with several portions of warm water. The hydrolysis liquor contained appreciable amounts of sugars, oligo-saccharides, and furfural from the hydrolysis of the carbohydrate constituents of the wood. The combined liquor and washings were repeatedly extracted with ether in a separatory funnel, the extracts evaporated to dryness, and the residue re-extracted with anhydrous ether. The ether-soluble fraction was separated into a bisulphite-soluble and a bisulphite-insoluble fraction using a 16% sodium bisulphite solution.

Chromatographic Separation

The bisulphite-soluble fraction, dissolved in ether,

Table I. R_F Values and Color Reactions

Compound	R_F value: Organic phase	R_F value: Aqueous phase	Color reaction: Phloroglucinol/HCl[a]	Color reaction: Benzidine/AcOH[b]
Unidentified	0.0	?	Purple	Brown
5-Hydroxymethylfurfural	0.05	0.83	Brown	Reddish brown
p-Courmaraldehyde	0.10	0.55	Red	Lt. brown
Coniferylaldehyde	0.38	0.45	Magenta	Orange
Vanillin	0.55	0.78	Peach	Yellow
Vanilloyl methyl ketone	0.78	0.87	Pink	...

[a] 0.1 *M* phloroglucinol in 95% ethanol (5 vol.), HCl conc. (1 vol.).
[b] 2% benzidine in 50% acetic acid.

Table III. Ultraviolet Absorption Characteristics (λ_{max}, mmu)

Compound	Eluted: Neutral[a]	Eluted: Alkaline[b]	Authentic: Neutral[a]	Authentic: Alkaline[b]
Coniferylaldehyde	342	403	342	404
p-Coumaraldehyde	324	380	327	385
Vanillin	310	348	312	347
Vanilloyl methyl ketone	320	360[c]	323	368[c]
5-Hydroxymethylfurfural	282	282	285	...

[a] Solvent 95% ethanol.
[b] Solvent pH 12 buffer.
[c] Solvent 2% $(CH_3)_4NOH$ in aqueous ethanol (*17*).

was concentrated to a small volume, spotted on Whatman no. 1 filter paper, and chromatographed according to the descending method. As the mobile phase, both the organic and the aqueous phases of Lindstedt's (*15*) equilibrated mixture of benzene, ligroin, methanol, and water (50 : 50 : 1 : 50) were employed. The air-dried chromatograms were examined after spraying with phloroglucinol/HCl or benzidine/acetic acid; after spraying with diazotized sulphanilic acid; and under ultraviolet light, both directly, or after exposure to ammonia vapors.

Among at least six compounds giving rise to distinctly colored spots after spraying with phloroglucinol/HCl or benzidine/acetic acid (Table I), coniferylaldehyde, *p*-coumaraldehyde, vanillin, vanilloyl methyl ketone, and 5-hydroxymethylfurfural were identified by means of their R_F values (in both solvents), color reactions, and ultraviolet absorption characteristics in neutral and alkaline solution, all of which were identical with those of authentic samples.

Solutions for the ultraviolet absorption measurements were obtained by repeatedly eluting with methanol, concentrating and re-chromatographing zones from chromatograms applied as streaks on large sheets of filter paper. As a result of the reversal of the R_F values in the two solvent phases, this separation was greatly facilitated by the alternating use of the organic and aqueous phases of the solvent mixture. A typical example of the separation of some of the hydrolysis products is given in Table II.

The ultraviolet absorption characteristics of the eluted compounds and those of solutions of authentic samples are compared in Table III. The identification of 5-hydroxymethylfurfural was confirmed by the color reaction with aniline acetate (*16*) which resulted in an absorption maximum at 360 mmu.

After spraying of the chromatogram with diazotized sulphanilic acid and sodium carbonate, coniferylaldehyde gave a yellow spot, vanillin a pale yellow, vanilloyl methyl ketone an orange, and hydroxymethylfurfural a brown spot. In addition to these compounds, which had already been identified (Table I), there were present at least two distinct spots of pink color. The R_F values of these spots were 0.18 and 0.65 in the organic phase and 0.71 and 0.85 in the aqueous phase of the solvent system. Comparison with the R_F values and color reactions of the pure compounds listed in Table IV proved that the spot with R_F values 0.65 and 0.85 was due to guaiacyl acetone.

Inspection of Table IV indicates that the pink color reaction is given only by those compounds in which the carbonyl group is not conjugated with the benzene ring. Since the R_F values of the second pink spot (0.18 and 0.71) do not agree with those of β-oxyconiferyl alcohol, it is very probable that the spot is due to 1-hydroxy-1-(3-methoxy-4-hydroxyphenyl)-2-propanone (VI).

Under ultraviolet light, the spot due to coniferylaldehyde showed a bright blue-green fluorescence. After exposure of the chromatogram to ammonia vapor, the color of the fluorescence turned into a brilliant yellow-green, and the spot, previously invisible in daylight, turned yellow. The fluorescence colors of the other spots ranged in shade from a very dark blue to a bright purple. While these colors were hardly characteristic enough for identification of the compounds, their fluorescence helped greatly in locating spots prior to excision and elution of various zones.

Repeated Hydrolysis

The air-dried hydrolyzed wood meal was ether-extracted in a Soxhlet and the extract treated as described above. Chromatograms of the bisulphite-soluble fraction of this extract revealed the presence of all compounds listed in Table I. The spot for 5-hydroxymethylfurfural was very weak. In addition, there was present a very weak spot of purple-blue color after spraying with phloroglucinol/HCl with R_F 0.08 and 0.37, respectively, in the organic and the aqueous

Table II. Outline of Chromatographic Separation

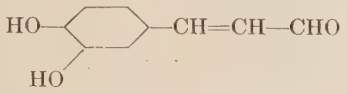
Starting material	R_F zones eluted and chromatographed with: Organic phase	Aqueous phase	Organic phase	Compound
Bisulphite fraction	0.0–0.2	0.33–0.48	0.08–0.11	*p*-Coumaraldehyde
			0.32–0.38	Trace of coniferylaldehyde
		0.65–0.85	0.16–0.20	Unidentified
			0.02–0.06	Hydroxymethylfurfural
	0.3–0.5	0.3–0.5		Coniferylaldehyde
		0.7–0.9		Vanillin

Table IV. R_F Values and Color Reactions with Sulphanilic Acid

Compound	Structure[a]	R_F Value: Organic phase	R_F Value: Aqueous phase	Color reaction[b]
β-Oxyconiferyl alcohol	R—CH_2—CO—CH_2OH	0.09	0.82	Pink
Unidentified (VI?)	(R—CHOH—CO—CH_3?)	0.18	0.71	Pink
α-Hydroxypropiovanillone (VII)	R—CO—CHOH—CH_3	0.25	0.86	None
Guiaiacyl acetone (V)	R—CH_2—CO—CH_3	0.65	0.85	Pink
Vanilloyl methyl ketone (IV)	R—CO—CO—CH_3	0.78	0.87	Orange

[a] R = 3-methoxy-4-hydroxyphenyl.
[b] Diazotized sulphanilic acid followed by half-saturated Na_2CO_3 (*18*).

phase. The compound giving rise to this spot has been tentatively identified as caffeic aldehyde (VIII).



(VIII)

The ether extraction of the wood meal was repeated twice. The third extract was free of coniferylaldehyde; yet the extracted wood meal still gave the characteristic purple color reaction with phloroglucinol as strong as, or stronger than, the original, solvent-extracted wood. The wood meal was next subjected to a second hydrolysis under the same conditions as the first one. Ether extracts from the liquor and from the twice hydrolyzed wood again contained coniferylaldehyde, *p*-coumaraldehyde, and the other cleavage products in approximately the same amounts as the extracts from the first hydrolysis.

Ethanol extraction of the ether-extracted, twice hydrolyzed wood meal yielded an alcohol-soluble, ether-insoluble "hydrolysis lignin." Detailed chromatographic and chemical characterization of this fraction, which gave a strong color reaction with phloroglucinol, has not yet been carried out. The ultraviolet absorption spectrum of the ethanol-soluble fraction is shown in Fig. 2.

A third hydrolysis carried out with the ethanol-extracted wood meal resulted in the formation of additional amounts of coniferylaldehyde and the other hydrolysis products.

An investigation of the bisulphite-insoluble fractions of the ether extracts from the hydrolysis liquor and hydrolyzed wood is in progress.

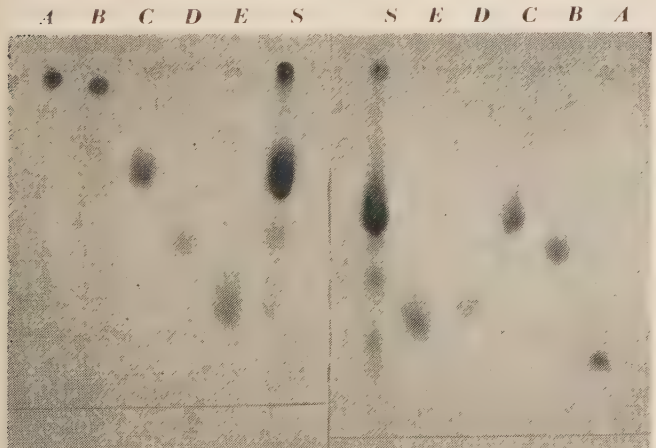


Fig. 1. Chromatograms showing 5-hydroxymethylfurfural (A), p-coumaraldehyde (B), coniferylaldehyde (C), vanillin (D), vanilloyl methyl ketone (E), and bisulphite-soluble fraction of ether extract from aqueous hydrolysis liquor of western hemlock (S), developed in organic phase (left), and aqueous phase (right), sprayed with phloroglucinol/HCl

Hydrolysis of Brauns' Native Lignin

Native lignin was prepared from hemlock wood by a variation of the procedure originally used by Brauns (*19*). Hammer-milled western hemlock chips were extracted with warm 95% ethanol until the extract was colorless. The ethanol extract was reduced to a small volume and then poured into warm water. The precipitate was filtered off, re-dissolved in dioxane, and re-precipitated into warm water. Sugars and other carbohydrates remained in the aqueous filtrate. The water-insoluble precipitate was re-dissolved in dioxane and then poured into absolute ether. The ether-insoluble precipitate was then washed with warm ether to ensure removal of all ether-soluble material. The purified native lignin was light tan in color.

Approximately 0.75 gram of the native lignin was suspended in 150 ml. of water. A little sodium oleate was added to aid the dispersion of the lignin particles which were strongly hydrophobic. The mixture was heated in a small autoclave for 1 hr. at 175 °C. and then extracted with ether until the ether-extractables were removed. The ether-extracted mixture was re-cooked under the same conditions and re-extracted with ether. The original native lignin and the two ether extracts

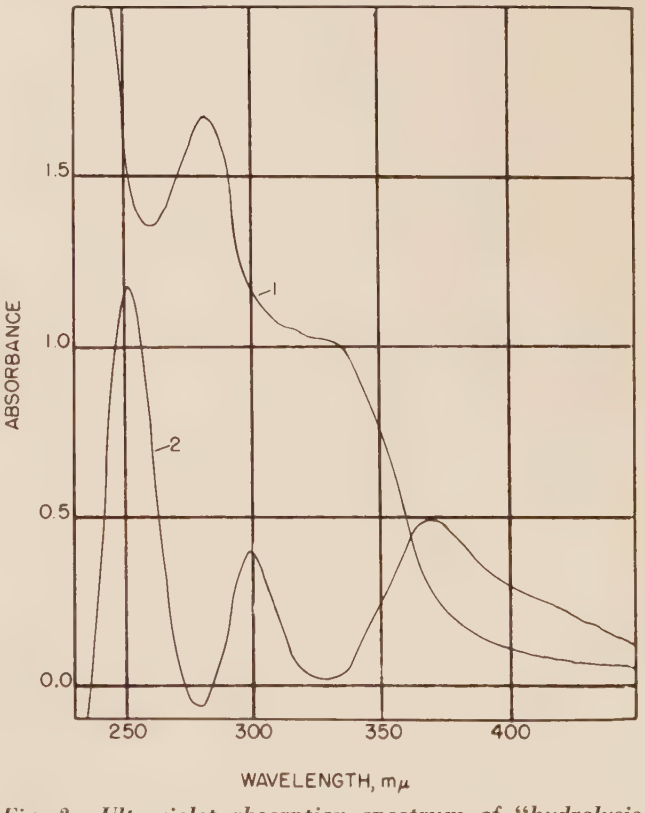


Fig. 2. Ultraviolet absorption spectrum of "hydrolysis lignin" in ethanol (curve 1). Difference curve between alkaline (pH 12) and neutral solution (curve 2)

were then chromatographed according to the previously described procedure. The original native lignin showed one spot at $R_F = 0$. Chromatograms of the ether extract from the first cook showed the presence of coniferylaldehyde, *p*-coumaraldehyde, vanillin, vanilloyl methyl ketone, and small amounts of several unidentified phenols. The ether extract from the second cook contained approximately the same amounts of coniferylaldehyde, *p*-coumaraldehyde, and the other cleavage products as the ether extract from the first cook. An estimate of the yield of coniferylaldehyde in the combined ether extracts from the two cooks was obtained from the absorption maximum near 400 mmu of the difference spectrum between an alkaline and a neutral solution. This indicated a yield of 3 to 4% coniferylaldehyde based on the original native lignin.

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Received Aug. 1, 1955.

Contribution No. 15 from the Research Div., Rayonier Inc., Shelton, Wash.

The author's thanks are due to Professor K. Freudenberg, Heidelberg University, and to J. C. Pew, Forest Products Laboratory, Madison, for the gift of authentic samples of *p*-coumaraldehyde and coniferylaldehyde, to Mrs. E. V. Coffman for assistance with the experiments, and to H. L. Hergert of this laboratory for the preparation and hydrolysis of native lignin and for many most valuable suggestions and discussions.

The Abatement of Kraft Pulp Mill Odors by Burning

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The main sources of kraft mill odors and atmospheric sulphur losses are reviewed. Recovery systems for the elimination of the major losses and, in particular, an installation to destroy the odor nuisance associated with the digester relief and blow-gases are described.

Atmospheric pollution by kraft pulp mills is by no means a new problem, but it is one that is becoming increasingly more important. There occurs in some communities a remarkable expansion of the number and capacities of kraft pulp mills and of many other industries as well. The result is that at some localities the point has been reached where the atmosphere cannot be used any more as an "infinite diluent."

It has long been known that the objectionable gases which cause the nuisances are primarily sulphur compounds. These sulphur compounds, in the case of kraft pulp mills using soft wood like Douglas-fir, are: hydrogen sulphide, methyl mercaptan, dimethyl sulphide, some dimethyl disulphide, and an insignificant amount of other sulphur compounds. The odor threshold detection values of these compounds have been determined by the U. S. Public Health Service (*1*). The concentrations of hydrogen sulphide, methyl mercaptan, and dimethyl sulphide that are detectable by the average person as a faint odor are as low as 1.1 micrograms per liter. Concentrations of this magnitude are extremely difficult to evaluate and to eliminate.

Because of the many conflicting reports in the literature and the varying opinions among operators as to the relative importance of the different sources, an investigation was made to supply the necessary information on the quantities of sulphur compounds released to the atmosphere (*2*). The same method of analysis was applied to all gases. The results explained partly the differences found by different investigators. The quantities released depend not only on the type of equipment used, but also very much on the methods of operation.

In the recovery system, liberation of hydrogen sulphide by the reaction of carbon dioxide contained in the flue gases with sodium sulphide in the black liquor is greatly reduced by treating the black liquor with air prior to the evaporation. Laboratory tests, pilot plant investigations, and the operation of a large scale black liquor oxidation tower have been reported (*3*). The mill scale installation has operated satisfactorily for several years.

Another major source of sulphur losses is hydrogen sulphide developed in the recovery furnace. Sulphur dioxide and hydrogen sulphide, including a relatively small amount of organic sulphur compounds that are present, were measured separately. A few typical results are given in Table I. These data represent a furnace operating cycle in which air was varied from sufficient, through insufficient, and back to sufficient to control sulphur losses. The concentrations were determined almost continuously over a long period of time, while simultaneously oxygen determinations of the flue gases were made. The results showed that the development of hydrogen sulphide and other organic sulphide compounds can practically be eliminated by proper operation of the furnace. In addition, the heat economy is improved. There was some question, at first, as to whether the reduction of the hydrogen sulphide content would involve an increase of the sul-

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phur dioxide concentration but this was the case only to a limited degree. In fact, the recovery systems we tested never showed substantial sulphur losses in the form of sulphur dioxide contained in the gases entering the recovery furnace stack.

In order to maintain a careful control of the operating conditions of the furnace, oxygen determinations are made. The oxygen concentrations were at first determined periodically with Orsat-type equipment but are now recorded continuously with a suitable oxygen recorder.

Another smaller source of hydrogen sulphide released to the atmosphere is the lime kiln. The analysis of the stack gases after the wet scrubber, made continuously over a period of time, showed that the losses are eliminated by operating the kiln with the proper amount of air.

An interesting survey made by the Alkaline Pulping Committee of TAPPI (*4*) showed that of the 30 mills questioned, 11 mills burned digester relief and blow-gases in the recovery furnace and three used other means of burning. Waste bleach liquor was used by two mills. Other mills used chlorine and ozone. Some have made attempts to collect the gases. More recently, Hisey (*5*) described the application of the black liquor oxidation tower as a means of oxidation and absorption of the sulphur compounds contained in the digester relief gases. Sands and Schmidt (*6*) summarize work that has been done to remove hydrogen sulphide and organic sulphur compounds from synthesis gas using catalysts. Dexter (*7*) mentions oxidation in the presence of catalysts to render obnoxious gases, which result from the alkaline cooking process, harmless.

Woodword (*8*) published results of an extensive investigation of the use of chlorine dioxide to eliminate objectionable odors of hydrogen sulphide, organic sulphur compounds, and of many other organic compounds as well. Routala and Jaatela (*9*) suggest a process based on the absorption of these compounds by wood chips and sawdust. Gas holders have been used to collect the noncondensable digester relief and blow-gases (*9*, *10*). Meuly and Tremaine (*11*), Zirm (*12*), and Von Bergen (*13*) describe a method of odor abatement involving a low initial investment that is based on masking the kraft mill odor with the odor of special agents, rather than on recovery or conversion of the malodorous compounds.

MEASUREMENT

By determining the concentrations of the sulphur-containing gases, the most efficient processes can be selected for counteracting them. The analytical methods used have been previously described (*2*) with the exception of a technique that corresponds to a modified gas-analysis apparatus of the Orsat type.

The "Chemical Engineer's Handbook," by Perry, gives the limits of inflammability of hydrogen sulphide in air as 4.3 and 45.5% of total volume (*14*). The lower limit for turpentine is only 0.8%. Data for methyl sulphide and methyl mercaptan are not available. However, a study of the explosive nature of the digester relief and blow-gases has been made by Ginodman (*15*). It is considered necessary for safe operation to dilute the relief gases with not less than

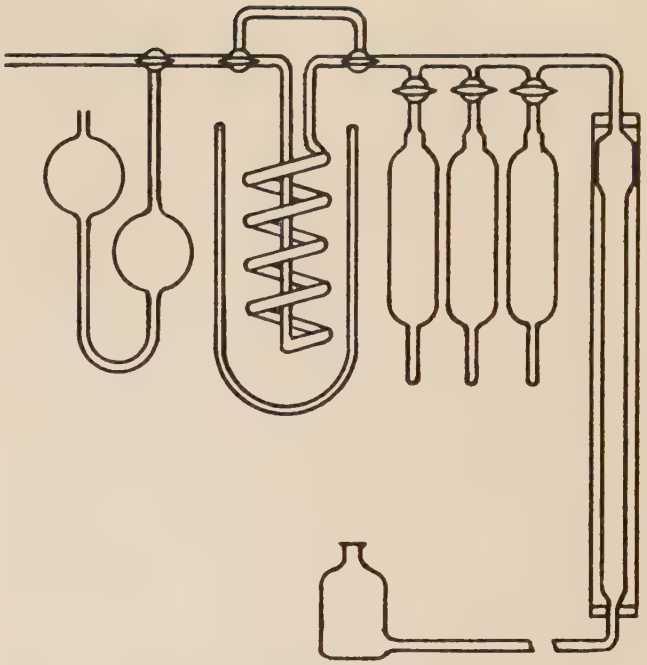

Fig. 1. Sketch of modified Orsat gas analyzer with dry ice freezing chamber to remove organics

50 volumes of air. As the inflammability of a gas depends on the concentration of the organic compounds and of the oxygen rather than on the concentration of just the sulphur compounds, a method to measure the oxygen content and the total amount of organic compounds (including hydrogen sulphide) was required.

The Orsat-type gas analysis of taking a measured volume of gas sample, removing various compounds by suitable reactions, and measuring the decrease in volume caused by each removal is relatively simple. Of the compounds contained in digester relief and blow-gases, hydrogen sulphide and methyl mercaptan are readily absorbed in a solution containing about 500 grams of KOH per liter of solution. However, dimethyl sulphide and most of the other organic compounds are only partly dissolved in the potassium hydroxide solution. The vapor pressures of dimethyl sulphide, dimethyl disulphide, and all the organic compounds that can be present in significant quantities are relatively low at the temperature of sublimating dry ice. Therefore, these components can be removed by passing the gas through a dry ice condenser. However, simultaneously with the methyl sulphide and the other organic compounds, water is removed also. Moisture equilibrium is re-established by passing the gas through a second potassium hydroxide solution. After the treatment with the second potassium hydroxide solution the pressure of the gas is adjusted by bringing both menisci in the manometer to the same level and the volume absorbed, indicating the total amount of sulphur and organic compounds, is determined. Oxygen is removed by passing the gas through a third pipet containing a solution obtained by mixing 1 volume of a solution containing 300 grams of pyrogallic acid per liter with 5 volumes of the above-mentioned potassium hydroxide solution. A schematic layout of the apparatus is shown in Fig. 1. Mercury is used as confining liquid in the buret. A regular manometer and compensator tube connected to the buret is not indicated in the figure. The gas

Table I. Furnace Operation

Period	Black liquor flow, lb./hr.	Black liquor solids, %	Air flow total, lb./hr.	Primary air flow, lb./hr.	Steam flow, lb./hr.	Odorous sulphur comp., mg./l.[a]	Oxygen, %	Carbon monoxide, %
1	90,000	61–62	220,000	119,000	142,000	0.035	1.9	0.2
2	90,000	61–62	210,000	117,000	135,000	0.21	0.6	0.5
3	90,000	61–62	230,000	122,000	145,000	0.022	2.3	0.2

[a] Based on 1 liter of flue gas at 300°F. and containing 30% water vapor.

sample is passed at least four times back and forth through the "dry ice condenser" and the storage pipet containing a confining liquid. All glass tube connections, with the exception of the condenser, are capillary tubing.

COOKING CONDITIONS AND QUANTITIES RELIEVED

In order to investigate the liberation of malodorous sulphur compounds under various cooking conditions, the relief of the pilot plant digester was collected. The accumulator consisted of a large stainless steel tank. The sodium hydroxide solution in the bottom of this tank absorbed all the hydrogen sulphide and methyl mercaptan and a part of the dimethyl sulphide. An eductor was used to support the absorption. The volume of this tank was sufficient to contain the condensate and the noncondensable gases from the digester without an appreciable increase of the pressure. At the end of the cook the vapors were released in the accumulator tank until the pressure dropped to less than 20% of the initial highest pressure. The amounts of hydrogen sulphide, mercaptan, and dimethyl sulphide collected were determined. The time necessary to reach the maximum cooking temperature was the same for all cooks. The results are given in Table II. The active alkali (as Na_2O) used is calculated on the basis of the amount of oven-dry wood filled in the digester. The sulphidity (as Na_2O) is a percentage of the active alkali. The sulphur compounds are calculated as sulphur. One cook, no. 4, was prehydrolyzed with steam.

Under mill conditions the sulphidity is kept in the range of 15 to 25%. Tests nos. 2 and 3 shows that a change of 18 to 22.5% did not materially influence the amount of hydrogen sulphide, methyl mercaptan, and dimethyl sulphide developed. The prehydrolyzed cook test no. 4, contained a little more active alkali that might have influenced the results to a limited degree. However, it is obvious that prehydrolysis did not result in any substantial reduction.

A change of the temperature in the digester results in a considerable change in the yield and pulp qualities. In order to compensate for this effect, the alkalinity or the cooking time was changed in such a way that approximately the same pulp yield was obtained in spite of the rise or drop in cooking temperature. The ratio of sulphide to total active alkali was kept constant for the comparable runs nos. 5, 6, 7, and 8. The results show a very significant effect of the temperature. While the amount of chemical and the cooking time were reduced substantially, the increase of the temperature resulted in a considerable increase of the amount of volatile malodorous compounds developed.

Test no. 9 shows the results obtained with a charge of black liquor, without the addition of chips. The amount of black liquor corresponded to the quantity present in the digester at the end of one of the previous cooks. The quantities of mercaptan and dimethyl sulphide obtained by subjecting the black liquor once more to the cooking temperature are insignificant.

Losses of 2 to 3 lb. of methyl mercaptan, dimethyl sulphide, and some hydrogen sulphide per ton of oven-dry wood are well below the hydrogen sulphide losses found in the recovery furnace stack gases under unfavorable operating conditions. However, after the realization of black liquor oxidation and the establishment of a suitable control of furnace operation, the digester relief and blow-gases are the most serious source of obnoxious odor.

SELECTION OF MEANS OF ABATEMENT

Since one mill was already operating a large scale oxidation tower, an investigation was carried out to indicate to what degree such a tower could be used to destroy the odorous compounds contained in the digester relief and blow-gases.

The test carried out with the laboratory oxidation tower with air containing known quantities of hydrogen sulfide, or methyl mercaptan, or dimethyl sulphide showed that the hydrogen sulphide was removed almost quantitatively. The results obtained with methyl mercaptan were less satisfactory. Although only about 5% of the mercaptan added to the air entering the tower could be detected as mercaptan in the air leaving the tower, approximately 40% appeared in the oxidized form as dimethyl disulphide. The threshold value of dimethyl disulphide is not so low as the corresponding

Table II. Volatile Sulphur Compounds from Pilot Plant Cooks

Cook no.	Max. temp., °C.	Total cooking time, hr.:min.	Active alkali, %	Sulphidity, %	Sulphur compounds H_2S[a]	CH_3SH[a]	$(CH_3)_2S$[a]	Total
1	172	3:45	18	0	0	0	0	0
2	172	3:45	16	22.5	0.29	1.60	0.88	2.77
3	172	3:45	16	18	0.25	1.29	0.99	2.53
4	172	3:45	19	18.5	0.18	1.25	0.88	2.31
5	150	5:30	20	20	Traces	0.29	0.17	0.46
6	160	4:00	20	20	Traces	0.35	0.35	0.70
7	170	4:00	16	20	...	1.15	0.74	1.89
8	182	3:00	16	20	...	1.49	1.25	2.84
9	172	3:00	..	...	...	0.15	0.05	0.2

[a] Pounds per ton oven-dry wood.

value of methyl mercaptan. Nevertheless, there is no doubt that dimethyl disulphide can contribute considerably to the obnoxious odors released by a kraft mill. The run with air containing a known amount of dimethyl sulphide showed that 90% passed the oxidation tower unchanged.

The efficiency of operation of any kind of equipment designed to destroy the obnoxious sulphur compounds contained in the digester relief and blow-gases depends on the flow pattern of the gases to be treated; especially if the flow of the blow-gases is very irregular. Peak flows of 5000 c.f.m. were measured. However, flows of noncondensable gases of this magnitude last only a very short time. As soon as the blow is over the flow reverses. The water vapor contained in the blow-gas cooling system condenses and gas or air is drawn back into the system. Regulation or control of gas flow, therefore, is of prime importance.

There are several good methods for the disposal after the gas flow has been regulated continuously to about 20 c.f.m. In one mill an oil burner was provided to burn the gases and convert the obnoxious and other organic compounds to carbon dioxide, sulphur dioxide, and water. In another mill producing bleached pulp the most efficient way was mixing the gases with the effluent of the chlorination washer. Tests showed that the odor of these gases was practically eliminated under the condition that sufficient residual chlorine was present; i.e., some excess residual chlorine should be left after the reaction is completed. Test data demonstrating this system are reported in Table III.

Although the tendency of the residual chlorine content to decrease on standing interfered slightly with the determination, it was obvious that practically all the sulphur compounds can be removed from the gas by chlorine oxidation. Under the conditions of the test, about 4 volumes of liquor were required per 1 volume of gas to provide sufficient chlorine to react with the hydrogen sulphide and organic compounds. There is enough chlorination effluent—containing residual chlorine—available to react with all the reactive compounds in the digester relief and blow-gases, and most of the combined condensates as well. Some of the results of the tests with a mixture of digester relief, blow, and evaporator condensate are given in Table IV. It should be noted that the determination of the sulphur compounds dissolved in the liquid before and after mixing are based on the hydrogen sulphide and mercaptan concentrations, while the determinations of the total sulphur compounds contained in the gas, given in Table III, involve all sulphur compounds. The reduction of the concentrations of the sulphur compounds by mixing the condensate with the chlorination effluent is caused partly by dilution and partly by reaction. The column indicating the percentage reduction is based on the amount of sulphur compounds decomposed by reaction.

Table III. Treatment of Digester Relief Gases with Chlorination Effluent

Test	*Mixture ratio dig. rel. gas:chlor. effl.*	*Total sulphur comp. in gas after treatment as sulphur, mg./l.*	*Removal from gas, %*	*Residual chlorine in effl., g./l.*
1	1:0	44	..	...
2	0:1	...	..	0.114
3	0.21:0.79	2.2	95	0.009
4	0.36:0.64	0.6	98	0.00
5	0.39:0.61	5.3	88	0.00
6	0.56:0.44	9.2	79	0.00

Table IV. Treatment of Evaporator, Digester Relief, and Blow Condensate with Chlorination Effluent

Test	*Mixture ratio—Condensate*	*Mixture ratio—Chlor. effl.*	*Sulphur comp. in condensate after mixing, mg./l.*	*Reduction by reaction, %*	*Residual chlorine in effl., g./l.*
1	1	0	35	..	...
2	0	1	...	..	0.09
3	0.5	0.5	11.6	34	0.0
4	0.33	0.67	5.8	50	Traces
5	0.25	0.75	2.5	72	0.009
6	0.2	0.8	Traces	98	0.011

In addition to well known devices like flame arresters and the design of the gas collection system in such a way that the presence of a critical amount of air is avoided, an arrangement involving a dilution of the gases with air before passing the burner was added. By mixing the concentrated gases with an excess of air the concentrations of the organic compounds are reduced below the limits of inflammability. Because this mixing can be done almost instantaneously at the place where the pipe from the gasometer—containing the concentrated gases—is connected to the air duct, the whole system can be kept free of explosive mixtures. Numerous tests have shown that the "pure" digester relief and blow-gases are practically free of oxygen. The results of some of these tests are given in Table V. From the viewpoint of safe operation, the gases should not contain more than 5% oxygen (concentrated gases) or not more than 0.5% of total organic compounds (with air-diluted gases) to be well below the limits of inflammability.

INSTALLATION AND TESTS

When the decision was reached to use some method other than the lime kiln or the recovery furnace to burn digester blow-gases and relief gases at Springfield, an Anthony furnace was selected to do the job on the basis of its performance at a southern kraft mill. This furnace is built by the Anthony Furnace Co. of Brooklyn, N. Y. (Fig. 2). It is a relatively small furnace, being about 12 ft. long and 72 in. in its maximum diameter. The whole unit is very sturdy in construction to stand moderately heavy explosions without damage.

Originally, the unit was equipped with an oil preheater so that bunker C fuel oil from the lime kiln could be used. Some trouble was experienced with tips fouling from this heavy grade of oil. Several months after the unit was put into operation we hit upon the scheme of using our turpentine from the decanter as fuel for the Anthony furnace, and thereby solved two problems, since turpentine is a relatively bad stream pollutant. Since this change in fuel we have had very little trouble with furnace operation. Fortunately, fuel demand and turpentine supply are very nearly balanced in our Springfield mill. We still maintain the oil line on a standby basis but very rarely use it.

Foul gases are mixed with dilution air and delivered to the secondary chamber of the furnace through a 6-in. tangential nozzle from a 1100-c.f.m. blower located adjacent to the furnace. Gas velocities range up to 90 ft. per sec. which is considered well above the rate of flame

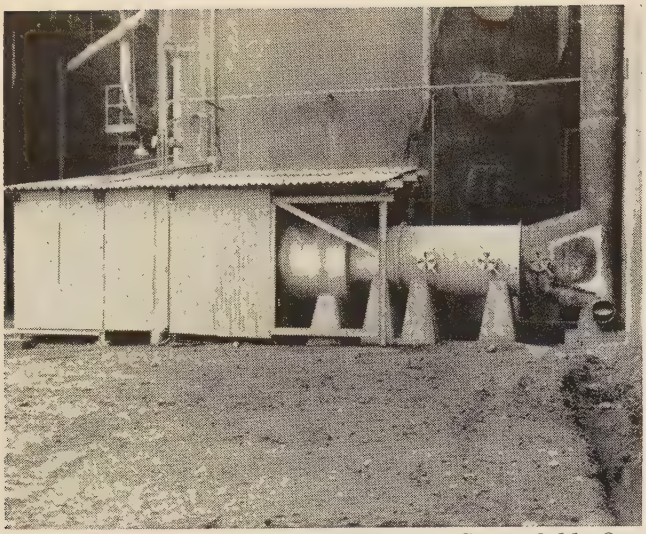

Fig. 2. Anthony furnace installation, Springfield, Ore.

propagation for digester blow and relief gases. A leaf-type flame arrestor separates the blower-furnace combination from the 8-in. delivery line. This line, however, is further protected by four soft safety heads distributed throughout the length of the pipeline. Dilution air is sucked into the line through a manually-set butterfly valve which is normally set to deliver air at about 900 c.f.m. Total flow through the line is recorded by means of an orifice-type flow recorder. At maximum flow of air (1100 c.f.m.) through this system a vacuum of 13 to 15 in. of water is maintained. Foul gas is delivered into the dilution air pipeline very close to the butterfly control valve to take advantage of the turbulence at this point to thoroughly mix the gas with the dilution air.

Preliminary laboratory studies had shown that all organic sulphides are destroyed at 1200°F. Therefore, an operating temperature of 1400°F. was selected as our initial base in order to be on the safe side. Flow of fuel to the Anthony furnace is closely controlled by a thermocouple in the entry to the afterburner furnace section activating an electronic controller unit. With only dilution air entering the secondary chamber, 1400 ± 20°F. was easily maintained. As soon as smooth furnace operation was attained, all relief gas noncondensables were turned into the dilution air system. Relief gas flow was very erratic, as was expected, varying from zero to short bursts of over 50 c.f.m. Under this type of operation, furnace temperatures would swing from the control temperature of 1400°F. to above the flame cut-out temperature of 1800°F. under conditions of maximum gas flow. As soon as the temperature dropped back into range the propane ignition system relighted the furnace flame. Under most operating conditions the above cycle went off without incident. However,

Table V. The Concentrations of Total Amount of Organic Compounds and Oxygen in the Digester Relief Gases

Tests	*Gas flow, c.f.m.*	*Gas temp., °F.*	*Total org. compounds, %*	*Oxygen, %*	*Inerts, %*
1	23	64	27.3	Traces	72.6
2	24	..	12.7	Traces	87.2
3	5	..	29.0	Traces	70.9
4	7	60	2.0	Traces	97.9
5	6	..	16.8	Traces	83.1

Table VI. Concentrations of Sulphur Compounds Contained in Digester Relief Gases

Test	*Total sulphur compounds as sulphur, mg./l.*	*Test*	*Total sulphur compounds as sulphur, mg./l.*
1	180	10	205
2	90	11	160
3	140	12	55
4	215	13	20
5	10	14	180
6	100	15	190
7	140	16	50
8	40	17	15
9	30	18	90

one complicating factor was encountered. Under certain conditions of heavy relieving, a turpentine mist was formed which was not removed in the condensers. When this hit the furnace, some moderately severe explosions did occur—which required manual resetting of the furnace controls before operations could be resumed. This condition was overcome by inserting a rock-filled shower box between the relief condensers and the dilution air line. The shower water from this box is sewered through the turpentine decanter.

With the furnace burning relief gases, tests were carried out to determine the concentration of the sulphur compounds. The results in Table VI represent the instantaneous concentrations found in the relief gas. These determinations were made at 10-min. intervals and demonstrate the wide variations in sulphur compounds normally expected in relief gases.

A number of determinations of the sulphur dioxide content and the odorous sulphur compounds left in the flue gas from the furnace indicated practically 100% conversion to sulphur dioxide when the burner control temperature was varied between 1100 and 1400°F. Since the most efficient furnace operation is that temperature at which all the odorous sulphur compounds are burned to sulphur dioxide, more determinations were made to establish this relationship during the initial experimental blow-gas run described below. These data are reported in Table VII.

In order to determine the lowest efficient operating temperature, the control temperature was gradually lowered while the flow of air-gas mixture was maintained constant. Each control point was allowed to stabilize before test data were taken. The flue gas leaving the furnace was tested for total sulphur and sulphur dioxide almost simultaneously, thus avoiding any significant interference by changing concentrations in the "input" gas. It will be noted from Table VII that below 900°F. a noticeable percentage of odorous sulphur compounds is not converted to sulphur dioxide.

With the successful operation on relief gases completed, thoughts were directed toward a system to handle digester blow-gases. About this time, the

Table VII. Operation of the Anthony Furnace at Various Temperatures

Test	*Temperature, °F.*	*Total sulphur compound, mg./l.*	*Sulphur dioxide, mg./l.*	*Odorous sulphur compounds, mg./l.*
1	1010	1.68	1.68	0
2	900	0.92	0.88	0.04
3	850	1.45	1.23	0.22
4	710	0.66	0.28	0.38

Government was offering surplus army barrage balloons for sale. Each balloon had a capacity of 3000 cu. ft. Three of these balloons would give the estimated capacity necessary and they could certainly be operated at low pressures.

The first step in installing the blow-gas collection system was to determine where air could get into the blow-gas stream and secure these places against air leaks. This included sealing off the blow tank stock level gage and increasing the loading on the blow tank vacuum breaker. The blow-gas condenser vent was equipped with a flapper-type lid fitted with a plywood gasket. This lid not only permits venting of blow-gases at this point when the disposal system is not in use, but also provides an emergency pressure release in the closed blow-gas line. With these alterations made, the noncondensable blow-gases were piped from the blow-gas condenser through a 28-in. light gage mild steel pipe to the barrage balloon header. The relief gas line was also piped into this header. At the top of the third balloon a fan was mounted to withdraw gas and discharge it, through a flow recording orifice, to the rock filter ahead of the dilution air line (described above) and then into the Anthony furnace.

Several safety features were built into this experimental system that are now being used in the permanent installation. As was mentioned earlier, the normal blow-gas condenser vent was equipped with a weighted flapper-lid which acts as a safety pressure release. A spring-loaded vacuum breaker was designed to allow gas to be sucked from the gas balloons back into the separator-blow tank system even if the blow condenser were to plug. A pressure release valve was installed on the barrage balloon header which was set to open at 3 in. of water pressure. An automatic switch was installed so that, if the furnace failed, the gas metering motor would stop and an automatic shutoff valve would close.

After the system was installed it was thoroughly checked out, using air instead of blow-gas. When the first blow was turned into the barrage balloons the two primary balloons were only about two-thirds full at the peak of the blow, indicating about 4000 cu. ft. of gas

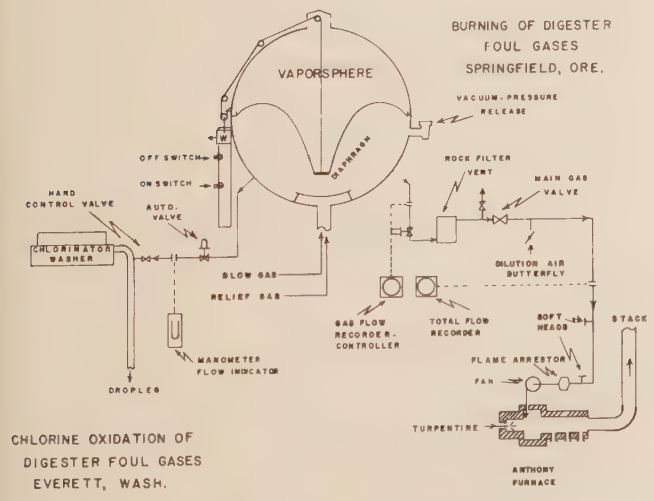

Fig. 3. Composite sketch of the two methods used for disposal of digester foul gases

Fig. 4. Vaporsphere and blow-gas system, Springfield, Ore.

flow. Shortly after the end of the blow most of the gas had been sucked back into the blow tank and the exhausting fan had pulled the balloons flat. Observation of the gas flow from 11 successive cooks established a value of 530 cu. ft. of combined blow-gas and relief gas discharged to the Anthony furnace per cook—approximately 65 cu. ft. per ton of pulp.

There are several types of gas holders available but our selection was complicated by the fact that the system should operate virtually at atmospheric pressures to minimize the possibility of gas leaks. Excessive back-pressure might also contribute to stock hangups in the digesters. On the other hand, if vacuum were allowed to develop in the system at any time, there would be danger of drawing unwanted air into the gas stream. Ultimately, the "Vaporsphere," manufactured by the Chicago Bridge and Iron Works, was selected. The construction features of this gas holder are shown in Fig. 3. The steel sphere is 27 ft. in diameter. A fabric diaphragm, in the shape of a hemisphere, is bolted to the shell with a retaining ring. A nonsparking aluminum plate is mounted in the center of the diaphragm as an anchor for the gage weight cable.

Figure 4 shows the vaporsphere installed at the Springfield mill.

In general, this gas holder has proved quite satisfactory for our purpose. However, hot turpentine fumes and other organic gases attack most plastics and all rubber fabrics of which diaphragms can be made, which have been tested to date. During the past year, we have used lightweight cotton canvas, tailored into hemispheres by local tent and awning companies, in the two gas holders currently in use. To make these dia-

Table VIII. Composition of Gas Contained in Vaporsphere

Test	*Total organic compounds, % (vol.)*	*Oxygen, % (vol.)*
1	21.0	5.8
2	5.0	16.0
3	10.5	3.7
4	21.1	8.5
5	10.5	3.5
6	9.5	2.9
7	9.7	1.8

Table IX. Concentrations of Sulphur Compounds of the Gases Contained in Vaporsphere

Test	Sulphur compounds as sulphur, mg./l.	Test	Sulphur compounds as sulphur, mg./l.
1	47	9	59
2	68	10	68
3	76	11	88
4	88	12	76
5	76	13	80
6	103	14	61
7	60	15	79
8	77	16	67

phragms gas-tight, they have been spray-painted with Tygon paint. Diaphragm life has varied from a few weeks to 5 months. At the present time we have on order a diaphragm consisting of a sandwich of du Pont Mylar between two sheets of lightweight canvas. Data on this material should be available in the near future.

With the Springfield experimental system converted to a permanent basis with the installation of a vaporsphere, further tests were made on the mixed gases as they were fed to the Anthony furnace. These data are reported in Tables VIII, IX, and X.

The results given in Table VIII show that most of the time the gas composition from the gas holder was satisfactory as far as safety standards mentioned earlier are concerned. However, at least twice during the test period of about 70 min. too much air had leaked into the system. This leakage occurred always after the sphere was completely emptied and the "pull" from the dilution air line to the burner still continued. An M.S.A. explosionmeter test confirmed that the gas was explosive during these periods of air infiltration. It is hard to prevent leakage of air into the system unless a very slight pressure of excess gas is maintained in the ducts and especially in the vaporsphere. The weight of the diaphragm on a minimum amount of gas in the vaporsphere is adequate to keep out air. Therefore, a solenoid valve was installed in the gas line to the furnace that stopped the flow of gas from the vaporsphere before the sphere was completely emptied. This has reduced air leakage to a minimum.

The determination of sulphur compounds shown in Table IX was made while there was a noticeable amount of gas in the vaporsphere. Considering the wide range of concentrations of sulphur compounds (see Table VI) and the intermittent release of digester relief gases, it is apparent that good mixing of gases is found in the vaporsphere. The results in Table X show a considerable reduction in the concentration of sulphur compounds after the concentrated gases (Table IX) have been mixed with air. The ratio of the sulphur compound concentrations before and after mixing indicates that about 30 volumes of air were added to 1 volume of gas.

Table X. Concentration of Sulphur Compounds in Gas after Mixing with Air

Test	Total sulphur compounds as sulphur, mg./l.
1	2.54
2	2.64
3	2.55
4	2.15

This ratio corresponds well with the measured flows of the concentrated gas and the gas mixed with air.

With the desirable advantages of nonexplosive oxidation offered by using chlorinator effluent, an efficient method for mixing the gases from the vaporsphere with the effluent was investigated. The Everett mill layout is such that the chlorination washer is quite close to the vaporsphere. Considering the tremendous amount of air normally entrained in a washer dropleg, it was felt an additional 20 c.f.m. of foul gases from the vaporsphere would not upset washer operation. As is shown in Fig. 3, that is the way the gas disposal system was installed. The turbulence of the dropleg gives intimate mixing of the foul gases with the chlorinator effluent with complete oxidation as proved by both smell tests and chemical analysis of the air vented from the chlorination foam breaker tower and from the sewer deaeration tank. Routine testing of our sewer effluent has at no time shown any sulphides or mercaptans to be present. Addition of the gas to the washer dropleg has in no way affected washer operation. For any mill manufacturing bleached kraft pulp, this method of accumulating and disposing of digester relief and blow-gases is very efficient and relatively inexpensive.

In the original planning for both the Springfield and Everett installations, blowers were installed to meter the gases from the vaporsphere to the disposal system. However, these blowers were found to be very real explosion hazards. The fan housings were next to impossible to make gas-tight, which released explosive mixtures of gases in the neighborhood of the driving motors. The possibility of an electric spark igniting such a mixture was always present. Also, if the rotor of the fan should happen to strike the housing, a spark could result with disastrous consequences. At Springfield, the blower was eliminated by taking advantage of the vacuum created in the dilution air duct to suck the gases from the vaporsphere. Once the foul gases are introduced to the dilution air, an explosion problem no longer exists. As was described above, the Everett system employs the vacuum of the chlorinator dropleg to withdraw the gases from the vaporsphere.

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Special acknowledgment is made to C. J. Lang for his assistance.

The Use of Polyamide Resin Suspensoids as Protective Coating for Paper

WILSON F. BROWN

A polyamide resin dispersed in water to form a suspensoid was investigated to determine its effectiveness as a coating for barrier type food packaging paper. Methyl cellulose, 100 cp., was used as a thickener so that the sheet could be coated properly. Glassine paper was used as the raw stock because of its excellent properties for food packaging. The coated sheet even at low coating weight gave complete resistance to penetration of peanut oil for a period of 1000 hr. when subjected to the oil at 73° F and 50% R.H. The results of the water vapor transmission tests on the coated sheet showed that the minimum amount of methyl cellulose should be used as a thickening agent because the greater the amount of methyl cellulose the higher the water vapor transmission rate. The water vapor transmission rate varies with the thickness of the coating. The transmission rate decreases until approximately 18 lb. of coating are applied and little effect is apparent on further increasing the weight of the coating. The addition of clay to promote leveling results in an increase of the transmission rate. Attempts to incorporate microcrystalline wax in the coating failed because the slightly alkaline wax emulsions were precipitated on mixing with the slightly acid suspensoids. A laboratory blade coater was developed for coating at constant speed and a method of operation was developed. Considerable information was obtained on the viscosity characteristics of the suspensoids. The suspensoids themselves appear to be pseudoplastic materials but when methyl cellulose is added some thixotropy is developed. The viscosities were obtained under carefully controlled conditions.

THE properties of the polyamide resins indicate a possibility of their use in coating on paper for barrier purposes in food packaging. The relatively low heat sealing temperature range of the compounds, the nonblocking, the grease or oil resistance, and the water vapor transmission resistance are properties of prime importance in food packaging papers. The compatability with numerous modifiers with ensuing variation of properties of the coated sheet suggest a wide range of applications for the material.

The polyamide resins are made by condensing polymerized unsaturated fatty acids with aliphatic amines. The resulting resins are ambered-colored thermoplastic polymers and range from hard solids which break readily at room temperature to soft and tacky materials. They can be readily dispersed in water to form suspensoids which are milklike liquids.

The coatings made with the polyamide resin suspensoids are capable of many different single functions as well as combinations of functions depending upon the composition of the coating, the base to which it is applied, and the weight or thickness applied.

The polyamide resin group of polymeric materials was discussed in general terms by Wittcoff, Renfrew, and Speyer (*1*). They suggested that these materials were suitable for paper coatings because they made the paper functional by imparting to it heat sealing properties as well as resistance to water vapor, grease, solvents, and chemicals. The preparation of the material in suspensoid form is discussed and the advantages of using the material in that form are pointed out.

Burgess and Swec (*2*) made a report on the progress in resin coating and gave new data on methods with a comparison of properties of six different hot melt plastic materials. The weights of coating applied were all about 2 mils in thickness with the exception of F.M. 6503 nylon which was used in a thickness of 1 mil.

Wittcoff, Peerman, Speyer, and Renfrew (*3*) discussed the aqueous dispersions of polymers, including the polyamide resin suspensoids, and presented data on particle size, viscosity, surface tension, stability, film properties, and the compatability of the polyamide resin suspensoids with a number of modifiers. They presented data also showing that the materials had excellent heat-sealing and blocking characteristics.

The polyamide resins may be coated on paper by at least three different methods; (1) the hot resin coating method, (2) the solvent method, and (3) the emulsion or suspensoid method. The emulsion or suspensoid-type method requires that the suspensoid be applied to the paper and after drying subjected to a higher temperature for a short period of time to cause the particles to fuse together thus forming a continuous film.

There are advantages and disadvantages with the several methods of application. The use of the water suspensoid type of coating does not require elaborate apparatus and in view of the wide industrial use of this method of coating was chosen as the method to be used in the first section of the research.

EQUIPMENT

The equipment used for the laboratory coating of the paper with the polyamide resin suspensoids consisted of an unroll stand, a blade coater, a constant speed device for pulling the paper, and an oven in which the coated sheets were fused.

An unroll stand was built with unroll shaft and knurled cones. A weighted strap-type brake was used to apply tension to the web and the bearing on one side had slotted holes to allow the alignment of the paper to the coater.

The blade coater was designed to simulate, insofar as practical, the operation of a commercial blade coater. The coater consisted of a flat steel plate superimposed on a steel box structure. Horizontal V-type supports were fastened near the front of the plate while a pair of 8-in. adjustable cams were positioned near the other

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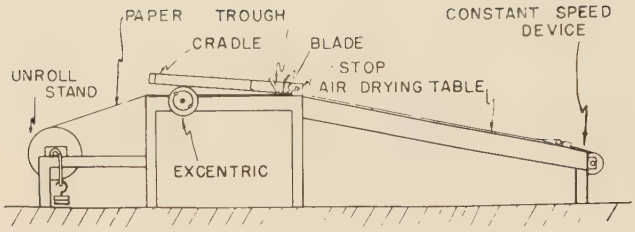

Fig. 1. Line drawing of coater

end of the plate. A cradle was constructed of two flat side bars fastened to a trough and blade at the front and a flat plate at the rear. The front end of the cradle fitted into the horizontal V supports while the rear of the cradle rested on the adjustable cams. A vertical blade was placed slightly behind the front of the cradle so that when the rear of the cradle was lifted a predetermined amount the blade was raised $^1/_{20}$ of that distance. The 8-in. cams were adjusted to slightly less than $^1/_{16}$ of an in. excentricity. A thin brass plate semicircular in shape and marked off into 90 divisions was placed on the outside of one of the cams. A movement of one division of the cam raises the blade about $^1/_{1800}$ of the amount of the excentricity. The blade was ground to fit a special insert in the base plate. It served also as the front end of the trough. A line drawing of the coater is shown in Fig. 1.

The constant speed device for pulling the paper was constructed in the following manner. A sloping table 6 ft. long was placed at the end of the coater. A winding shaft in suitable bearings with the proper sized winder pulley was bolted to the end of the table. The drive consisted of a motor working through a speed reducer and a loose belt drive with idler sheave. The latter served as a clutch for starting and stopping. A small rope was fastened to the winder shaft pulley and at the other end to a metal tube with a Y connection. The paper was fastened to the tube by means of gummed tape. When the loose pulley was tightened the paper came up to speed within 6 in. of travel and continued at constant speed until stopped. Selection of pulley size on the winder shaft and changing of sheaves on the loose belt clutch allowed speeds in a range from 30 to close to 300 f.p.m.

The heating unit for fusing the coating was built in three sections. Each section consisted of a steel plate with two 1500 w. strip heaters bolted to the underneath side. The plate was set 2 in. from the bottom of a sheet metal box open at both ends. Small brass rods were spaced 3 in. apart for the paper to ride on and were approximately 2 in. above the steel plate. The temperature of the plate was maintained at 300°F.

METHODS

Operation of the Coater

The machine was fitted with the proper winder pulley to obtain the desired speed and the 8-in. cam positioned at zero setting. The bolts holding the blade were loosened and a piece of paper of the type that was to be used was placed under the blade. The blade was allowed to rest on the paper with its own weight and the bolts tightened. The cam was then adjusted so that the desired weight of coating would be placed on the paper.

The coater was threaded by pulling the web by hand up over the end of the base plate and across it to a distance of about 8 in. beyond. The end of the web was secured to the metal rod by gummed tape and all slack removed from the web. The cradle was then placed in position and the proper setting made. The coating was poured into the trough and the paper brought up to speed quickly. When a sufficient length of paper had been coated the operation was stopped. The first 10 in. of the coated sheet and the wet portion at the other end were trimmed off as the sheet air dried. It was then placed in the heating oven for the requisite time, removed, cooled, and hung in the constant humidity room for conditioning.

It was necessary to control the temperature of the coating mixture because of the effect of temperature on the viscosity. The coater setting gave a straight line relationship with weight of coating as shown by Fig. 2.

Thickener for Coating Mixtures

Methyl cellulose, 100 cp., was selected as the thickening agent. The methyl cellulose was dissolved in water to form a 10% solution and allowed to stand overnight to make sure that all of the material was dissolved. The thickening agent was added to the polyamide resin suspensoid on the basis of weight per cent of the solid content. The thickener was incorporated in the polyamide resin suspensoid with thorough agitation taking care that as little air as possible was stirred into the mixture. The coating mixture was then screened through a 120-mesh stainless steel screen to remove any possible lumps or extraneous material.

Wax Preparation

Microcrystalline wax was used to make 50% wax emulsion. Five hundred grams of wax was melted in a container approximately $2^1/_2$ times the volume of the emulsion desired and brought to a temperature of 200°F. To this 28.4 grams of oleic acid were added with stirring and the temperature brought back to 200°F., after which 21.6 grams of morpholine were then added slowly with good agitation until the mixture became homogeneous and the temperature again brought back to 200°F. Finally 450 grams water at a temperature of 200°F. were added with high speed

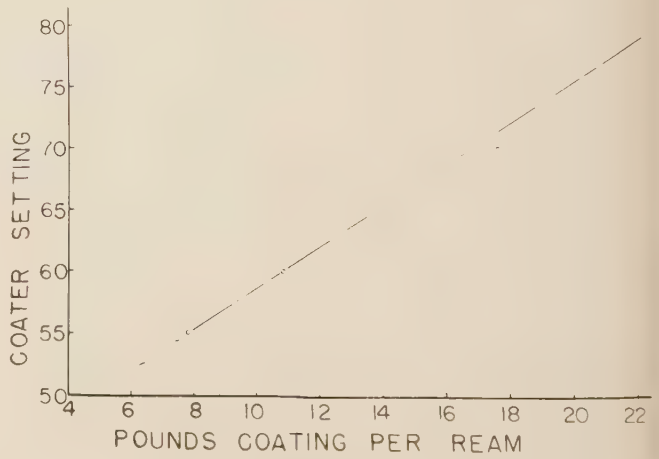

Fig. 2. Effect of coater setting

agitation. The agitation was continued until complete emulsification was accomplished. The emulsion was then stirred slowly until it had cooled well below the melting point of the wax. The emulsion was allowed to age until free of air and stirred slowly before use.

Clay Addition

The desired weight of moisture-free clay was made into a paste by the addition of a small amount of the polyamide resin suspensoid. The rest of the suspensoid was added slowly with constant agitation until the requisite amount had been added. The mixture was then stirred slowly for 15 min. and then screened through a 120-mesh stainless steel screen.

TEST METHODS

Water Vapor Transmission Rate

TAPPI Standard T 464, Water Vapor Permeability of Sheet Materials at High Temperature and Humidity (100°F. and 90% R.H.) were used in the tests. The desiccant used was fresh anhydrous calcium chloride. The sheets were sealed to the cups with the coated side exposed to the high humidity.

Crease Tests

Coated samples were creased for the oil test according to TAPPI Standard T 465.

Oil Test

The creased samples were tested for oil resistance by subjecting them to the action of refined peanut oil at a temperature of 73°F. and 50% R.H. for a minimum period of 1000 hr.

A glass ring 1-in. inside diameter and 1 in. high was sealed to the paper with rubber cement and allowed to dry thoroughly. The samples were then placed on a glass plate 4 in. wide and 20 in. long. One and one-half cubic centimeter of peanut oil were placed inside the glass rings. The plates were then put in a rack fastened to the wall. A mirror with face turned up and inclined slightly was fastened in a wooden box with open top and open front side. Readings were made daily for 42 days by positioning the glass plate over the mirror. Any penetration of the oil was readily detected. Triplicate samples were used to ensure accuracy at first, but later this was reduced to duplicate samples.

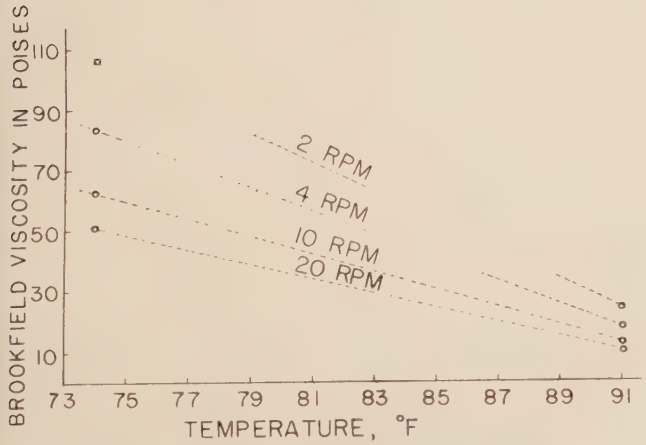

Fig. 3. Effect of temperature on viscosity

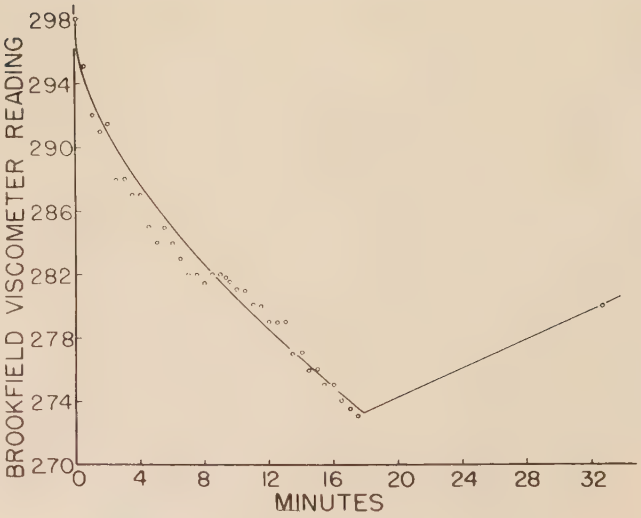

Fig. 4. Effect of stirring on viscosity

Enough racks were provided to take care of all samples to be tested.

Blocking Resistance

TAPPI Standard T 477, Blocking Resistance of Paper and Flexible Material, was used with a pressure of 0.5 p.s.i. and a time of 24 hr. at 75% R.H. and 100°F.

Heat Seal

The coated samples were sealed face to face for approximately 0.5 sec. at a pressure sufficient to ensure good contact and at a temperature of 250°F.

NOTES AND DISCUSSION

The Type of Paper Used

The paper used for coating was 25 lb. per ream (24 × 36—500) glassine. The glassine paper was chosen because it is a smooth dense sheet and in the uncoated state is a superior paper for packaging of food and food products. The formation is excellent and the basis weight is normally quite constant throughout the sheet. In addition glassine is strong and is resistant to water but has little resistance to water vapor. The maximum variation of weight in the machine direction of the glassine paper used was found to be ± 0.4 lb. per ream. Test samples taken at various places in a roll showed an average ream weight of 25 lb. which checked with the marking on the roll.

The standardizing and testing of the coater was carried out with a weakly sized paper. It was a 30 lb. per ream (24 × 36—500) bleached paper of poor formation. The clots of pulp were quite hard showing signs of severe calendering and the sheet was full of pin holes. When coating was applied to this sheet the water in the coating was absorbed very quickly by the paper. This caused immediate puckering of the sheet with consequent streaks and skips in the coated surface, especially when unthickened coatings were used. However, good coated sheets could be obtained by slightly thickening the coating, chilling to about 65°F. and using a speed of 200 f.p.m. on the coater.

Flow Properties of the Coating

The flow properties of the coatings used are related

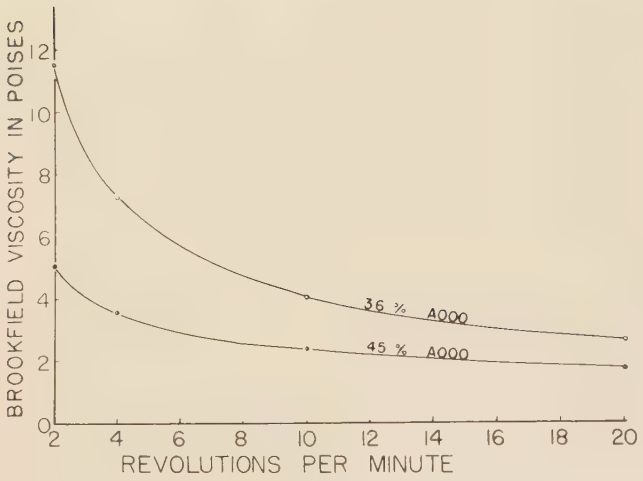

Fig. 5. Viscosities of suspensoids

directly to the paper used and must be adjusted to meet the conditions encountered. No pigment was used in these trials with the exception that the addition of clay was tried in one series. Glassine paper was selected for the trials as a standard to which the variations in coating could be related. The type of coater was restricted to the blade coater built for the trials. It was desired to use the polyamide resin suspensoid in as pure a state as possible for the purposes of the research.

The solid content of the coatings used was fixed when only a definite amount of thickening agent was used and varied from a low of 26% up to a maximum of 48% when clay was added to the coating. The effect of the solid content was masked to a great extent by the effect of increased viscosity at low solids.

The temperature of the coating mixture could be varied within limits as could be the speed of coating. Leveling agents were tried with little success although the addition of clay did improve the leveling to some extent. The most important property of the coating was the viscosity. Since the glassine paper was so dense the penetration of the water from the coating tended to be very slow. It was found that thickening the coating, that is, increasing the viscosity, to the proper point appeared to have the effect of holding back the water in the coating to some extent and that excellent coated sheets could be made.

Effect of Viscosity of Coating Mixtures

The viscosity measurements were made at a temperature of 86°F. or 30°C. A few runs were made at 74°F. for experimental purposes.

The temperature at which the viscosity measurements are taken must be very carefully controlled otherwise an appreciable error will result (see Fig. 3). One difficulty that was encountered on cool days was that the metallic spindles and side arms conducted heat quite rapidly from the coating being tested. The rate of stirring, in this case 20 r.p.m., was not sufficiently fast to obtain a uniform temperature when the water bath was held at 86°F. A difference of at least 1°F. was noticed between the coating at the center of the beaker and near the wall of the beaker even though the test was continued for more than 3 hr.

The amount of stirring at 20 r.p.m. when thickened coatings were tested had an appreciable effect on the viscosity. This would indicate that the coatings thickened with methyl cellulose had some degree of thixotropy whereas the polyamide resin suspensoids appeared to be of the pseudoplastic type. The effect of stirring is shown in Fig. 4. When stirring was discontinued the viscosity began to rise again.

In the normal viscosity measurements at 86°F. it was noticed that the reading usually changed very little after stirring for 30 min. at 20 r.p.m. Accordingly, a procedure was established in that the coating mixture was allowed to stand overnight, then thoroughly mixed and placed in the beaker. When temperature conditions became constant the mixture was stirred for 30 min. before making a viscosity reading.

There was a small difference in viscosity between the 36% no. A000 polyamide resin suspensoid and the 45% no. A000 with the latter being slightly lower. This is shown in Fig. 5. No difference could be noted in using the material in coating provided the difference in viscosity was taken into account.

Effect of Amount of Thickener

The effect on viscosity of the amount of methyl cellulose, 100 cp., used as a thickener is shown on Fig. 6. The graph shows the effect at the different speeds of the viscometer, in this case being 2, 4, 10, and 20 r.p.m.

The effect on the water vapor transmission rate of the addition of methyl cellulose, 100 cp., to the 36% no. A000 polyamide resin suspensoid is shown in Fig. 8. The samples tested were chosen from those coated sheets which had the same coating weight or as close to the same coating weight as possible. The graph shows that the water vapor transmission rate rises with increase in the amount of methyl cellulose.

Tests were made to determine the minimum and maximum viscosity of coating color for coating on glassine. The polyamide resin suspensoid gave rather streaked sheets even when the material was cooled

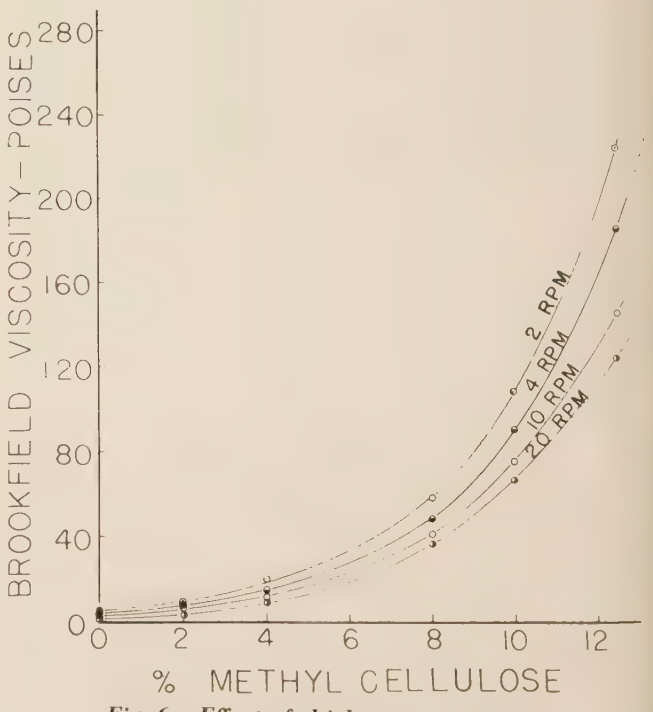

Fig. 6. Effect of thickener on viscosity

below normal temperatures. The coating material with 1% methyl cellulose gave good coated sheets if the temperature of the coating was kept around 70°F. or below. There was little trouble experienced with coating material containing 2% methyl cellulose. Very thick coating mixtures with viscosities as high as 200 poises when taken with the viscometer at 10 r.p.m. and 86°F. gave excellent sheets with no pattern or skips.

The water vapor transmission rate, on the other hand, was lowest at the lower percentages of methyl cellulose. It was necessary, therefore, to coat with a coating material containing the minimum amount of methyl cellulose or thickener.

Effect of Addition of Clay

It was thought originally that clay might be used as an extender and leveler because when clay was added to the coating it leveled out and gave an excellent appearing sheet. It was found quickly that although the oil resistance was unimpaired the water vapor transmission rate increased a large amount. The increase was to a point between two and three times the water vapor resistance of the coating without the clay added. The use of clay was therefore discontinued.

Fusing of the Coated Sheet

The ball and ring softening point of the polyamide resin used in preparing the no. A000 polyamide resin suspensoid is given as 95 to 105°C. (165 to 221°F.) The discrete particles in the dried coated sheet should fuse together at that temperature or slightly higher and they apparently do. A temperature of 250 to 300°F. was chosen for fusion. A time of 4 min. was used inasmuch as preliminary tests showed that no difference could be found in the water vapor transmission value from a fusion time of 2 min. up to a fusion time of 8 min.

Effect of Coating Weight

In general, it may be stated that the heavier the coating weight per ream, the lower the water vapor transmission rate. The curves obtained for different compositions are roughly parallel to each other. The minimum weight that would give the maximum effective resistance to water vapor appeared to be in the neighborhood of 20 to 22 lb. with little change after 18 lb. No information is available on coating weight higher than 22 lb. per ream. The relation between coating weight and water vapor transmission rate is shown in Fig. 8.

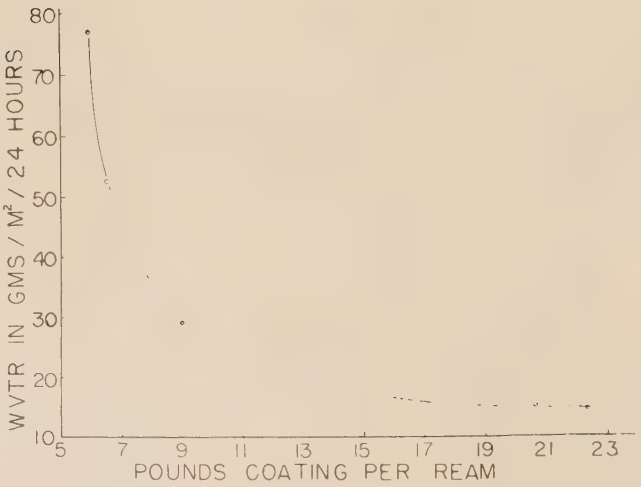

Fig. 8. Effect of weight on WVTR

It is much more difficult to determine the coating weight with accuracy in the laboratory than in the coating mill. The sample in this case was comparatively small being 2 in. wide and $5^1/_2$ in. long, and was weighed to the nearest milligram. The coated sheets were hung in the humidity room at 73°F. and 50% R.H. until they were properly conditioned. The samples were then cut and weighed either in the humidity room or were enclosed in cans and weighed at ordinary room temperature.

One factor that made the weight determination difficult was the variation of the weight of the uncoated sheet in the machine direction (see Table I). Test sheets taken every 2 in. showed a variation of 0.8 lb. per ream on glassine in a distance of 10 in. This was considerably less than other papers tested. Thirty-pound bleached paper showed a difference of 1.9 lb. in 6 in., while unbleached bag paper showed a difference of 2.1 lb. in 8 in. Since the coated test sheets were weighed against a tare sheet of uncoated paper the differences in weight of the tare sheet could cause considerable error.

Another source of possible error was due to the un-

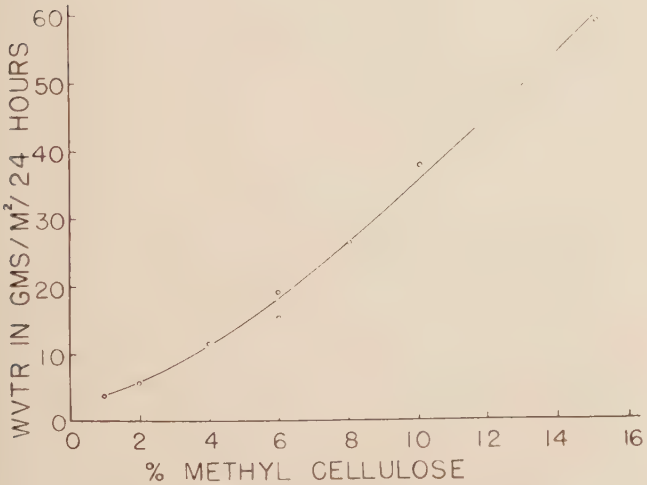

Fig. 7. Effect of thickener on WVTR

Table I. Weight Variation of Raw Stock in Machine Direction Every 2 In. in Pounds Per Ream

Sample	*Offset paper, lb./ream difference*	*Bag paper, lb./ream difference*	*Glassine, lb./ream difference*
1	0	0	0
2	0.35	−1.04	−0.53
3	−0.23	−1.39	−0.53
4	−0.23	0.23	−0.51
5	0.58	−1.04	−0.53
6	1.27	−1.16	−0.51
7	1.69	−0.35	−0.08
8	1.69	−1.85	0
9	1.16	−0.81	0.17
10	0.69	−0.46	0.27
11	0.35	−0.23	...
12	0.58	−0.35	...
13	−0.46	−1.27	...
Max	1.92	2.08	0.80

Note: Ream weight (24 × 36—500).

evenness of the paper. This was much less noticeable with glassine than with other papers. The presence of clots of pulp, even though very small, gave a hill and valley effect. The coating was apparently much thicker in the valleys than on the hills. It would be necessary therefore to put a slightly heavier coating on an uneven sheet to obtain the same vapor transmission rate when compared with the coating on a very smooth sheet.

In order to minimize the error due to the discrepancy of weight in the machine direction it was decided to use an average value for the uncoated tare sheet. It was not possible to overcome the hill and valley effect with ordinary sheets but since glassine is very much smoother than most other types of papers it was considered that averaging a number of trials would reduce this error sufficiently. In cutting the samples each direction was measured carefully and a variance of $^1/_{64}$ of an in. was considered sufficient cause to discard the sample.

Another factor that must be considered is the possibility of weight variance of the coating itself in the machine direction. This may happen when the height of the coating in the trough varies to an appreciable degree. It was necessary to keep the height of the coating in the trough reasonably constant.

The Oil Test

The oil test used in this work is a time-consuming test, but appears to represent more nearly conditions of end use of the paper. Peanut oil was selected because of its penetrating power and as a representative of the vegetable oils. All readings were terminated at the end of 1000 hr. as indicating sufficient oil resistance. One sample with a coating of 14.3 lb. per ream was continued for 4000 hr. with no penetration being observed.

There was no indication of oil penetration in any of the sheets coated with the polyamide resin suspensoids. This was true even with a coating weight of 2.9 lb. and regardless of the amount of methyl cellulose used as thickener up to an amount of 15% on the solids basis. The maximum results obtained on the uncoated glassine paper was 768 hr., although other tests showed a much lower reading. It was considered that the lower readings resulted from pores or pinholes.

Incorporation of Wax

It was planned to test the effect of the incorporation of microcrystalline wax on the water vapor transmission rate, provided the slightly alkaline wax emulsion could be incorporated into the cationic suspensoid. All attempts failed, however, since when the coating was applied a considerable number of scratches were present on the sheet apparently from crystals formed during the mixing of the wax emulsion with the coating. The subsequent fusing of the coating could not overcome the effect of the scratches.

Creased versus Uncreased Samples

The creasing of the samples for the oil test appeared to have no effect on the results. However, all samples for the oil test were creased.

It was decided to use the uncreased samples on the water vapor transmission test until such time when coatings which gave low transmission rates were developed. Table II shows the effect of creasing samples as against uncreased samples. No conclusions were drawn other than that creasing increased the water vapor transmission rate. It should be noted that no plasticizer was used in the coating for these tests.

Table II

Coating weight, lb./ream	*WVTR, creased sample*	*WVTR, uncreased sample*
8.1	12.8	6.0
11.7	10.5	7.0
15.0	7.9	3.8
19.3	8.2	6.3

Note: Water vapor transmission rate as grams per square meter per 24 hr. Ream weight (24 × 36—500).

Heat Sealing

The coated sheets can be heat sealed face to face to give excellent seals at temperatures of 200 to 300°F. The lower temperatures require approximately 1 to 2 sec. while the higher temperatures require less than 0.5 sec. Enough pressure must be exerted to obtain a good seal. After cooling to room temperature the seals were tested by pulling them apart. The paper usually tore, but occasionally just pulled up the fibers. In the latter case it was probable that not quite enough pressure was exerted in making the seal.

CONCLUSIONS

The use of polyamide resin suspensoid A000 with a small amount of thickening agent shows promise as a coating for barrier-type food packaging paper.

The coated sheet with a coating weight as low as 2.8 lb. per ream shows no penetration of peanut oil at 1000 hr. at a temperature of 73°F. and relative humidity of 50%. The coated sheet, when a coating mixture containing 1% methyl cellulose is used for coating shows a water vapor transmission rate of 3.8 grams per sq. m. (equal to 0.25 grams per 100 sq. in.) per 24 hr. on testing at 100°F. and 90 to 95% R.H. Increasing the amount of methyl cellulose caused a rapid rise in the transmission rate. Incorporation of clay as a leveling agent and extender also caused an increase in the transmission rate. In general, also, it was found that the thicker or heavier the coating weight the lower the water vapor transmission rate.

A laboratory blade coater was constructed for use in coating the glassine paper with the polyamide resin suspensoid and a method of coating was developed that worked very well. The coating was laid down as contiguous discrete particles which required fusion at an elevated temperature to produce a continuous film of coating on the paper.

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Received Feb. 9, 1955. Presented at the 40th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 21–24, 1955.

Correlation of Accessibility of Cellulose with Acetylation Rate

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It has been shown that a chromium trioxide oxidation method for determining "accessibility" of cellulose correlates well with actual measurements of acetylation rate. Both of these measurements vary with moisture content of the cellulose and the method by which the moisture content has been achieved. Since the direct measurement of rate of acetylation is simple, its use is recommended when acetylation behavior is to be predicted. Accessibilities determined by moisture sorption methods, on the other hand, do not relate to acetylation rates. It is postulated that any method of measuring "accessibility" for a given reaction must employ a cellulose swollen to the degree which exists during the reaction. The correlation between the modified Glegg oxidation method and the rate measurements described here is believed due to the fact that both are carried out in the same medium, glacial acetic acid.

IT HAS been postulated frequently that celluloses, either native or regenerated, show differences in chemical reactivity related to the ratio of the amorphous to crystalline areas present in the fiber. Various methods have been described for the quantitative measurement of this ratio in order that reactivity or "accessibility" to reagents could be predicted. These methods fall into two general classes: physical or nondestructive methods, such as x-ray diffraction, (*12*, *15*) density (*11*, *24*), calorimetry (*16*), and water sorption (*9*, *10*, *14*, *22*); and chemical or destructive methods which include a large number of hydrolysis techniques (*1*, *2*, *5*, *17*, *18*, *20*), formylation (*3*, *19*, *23*), acetylation (*4*), and oxidation (*8*).

In the preparation of cellulose acetate it has been observed that the suitability of celluloses for acid catalyzed esterifications in acetic acid/acetic anhydride medium can vary rather widely depending on previous history (i.e., source, method of purification, method of drying, etc.). Some simple method for measuring the "accessibility" of a cellulose to acetylation reagents would be very desirable in determining the choice of suitable raw materials for the manufacture of cellulose acetate.

Howsmon, (*14*), Ward, (*25*), Tarkow (*23*), and Nickerson (*19*) have pointed out the distinction between the degree of crystallinity, as measured by physical methods, and the amount of reactive cellulose, which is far more important to the carrying out of chemical processes. It is generally agreed that, while for any given set of conditions, accessibility (i.e., per cent of reactive material) can be determined exactly, the results obtained by different methods will vary widely as a function of the size and polarity of the reagent molecule and the degree of swelling of the cellulose in the medium used. Thus, the amount of pertinent information obtained from chemical accessibility measurements is largely dependent on a wise choice of suitable reaction conditions.

In considering available chemical methods for the determination of accessibility which might serve to predict acetylation behavior, it was postulated that any reaction used should be carried out in such a way that the degree of swelling of the cellulose would be essentially the same as in the acetylation reaction. Thus, measurements of accessibility by hydrolysis (*1*, *2*, *5*, *17*, *18*, *20*) in aqueous media which produce a high degree of swelling would be excluded. The formylation techniques of Tarkow (*23*) and Nickerson (*19*) were rejected for a similar reason since the reagent, 85 to 90% formic acid, is comparable to water as a swelling agent. The procedure of Glegg, (*7*) oxidation in anhydrous acetic acid, appeared of interest principally because the determination was carried out in a medium similar to that used in one of the commercial processes for the acetylation of cellulose. This procedure was, therefore, investigated further.

OXIDATIVE METHOD FOR DETERMINATION OF ACCESSIBILITY

Glegg's method for determining the accessibility of cellulose is based on the observation of Gladding and Purves (*6*) "that chromium trioxide in an acetic acid/acetic anhydride mixture rapidly oxidized dry, swollen cotton linters, hardly oxidized dry, unswollen linters, and did not oxidize dry, powdered starch appreciably. It thus appeared that as a nonswelling system the chromium trioxide solution was sharply limited in its action to the accessible cellulose." In his work, Glegg was particularly interested in the effect of various aqueous swelling treatments on accessibility. In the experiments described here, on the other hand, emphasis was placed on the possibility of detecting differences in the accessibility of different celluloses, as measured by the chromium trioxide oxidation, when these celluloses had been subjected only to the mild swelling treatments generally used prior to esterification. Accordingly, the method of preparation of samples was modified extensively. The method used was as follows:

Samples of cellulose from various sources were shaken for 2 hr. at room temperature with glacial acetic acid in an amount equal to 35% of the weight of cellulose. They were then stored at +5°C. for not less than 16 hr.

Chromium trioxide (C.P. grade) was dissolved in a mixture of acetic acid/acetic anhydride (4 vol./1 vol.). The acetic anhydride was added, according to Glegg (*7*), to keep the system anhydrous and to prevent any swelling of the cellulose beyond its original condition.

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The solution was standardized against 0.1 *N* sodium thiosulphate.

An accurately weighed sample of cellulose (0.01 moles) was introduced into a glass-stoppered Erlenmeyer flask containing sufficient of an approximately

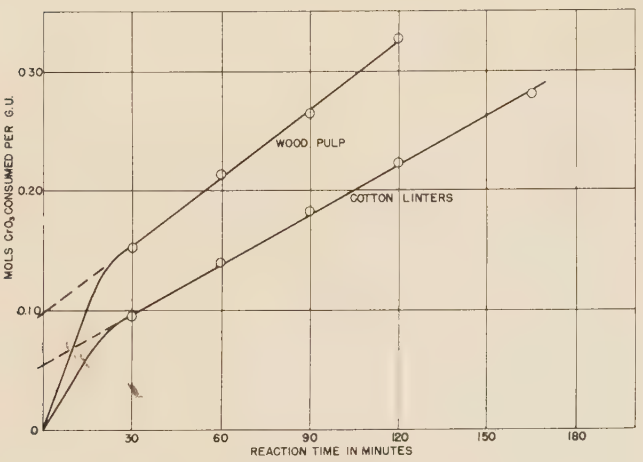

Fig. 1. Typical oxidation curve

0.01 *N* solution of chromium trioxide to give a molar ratio of approximately 1:1. The stoppered flask was kept in a constant temperature bath at 35°C. Aliquots (5 ml.) of supernatant liquid were pipetted at 30-min. intervals, diluted with 20 ml. distilled water and upon addition of 1 gram potassium iodide and 5 ml. 10% sulphuric acid, were titrated against 0.1 *N* sodium thiosulphate. The amount of chromium trioxide consumed by oxidation of cellulose was then calculated.

Blank experiments showed the oxidizing power of chromium trioxide to remain constant for periods of 2 to 4 hr., a period sufficient to obtain the necessary data.

Following the procedure of Glegg (*7*), the moles of chromium trioxide consumed per glucose unit were plotted versus time. The values obtained by extrapolation of the straight line portion of the curve to zero time represent the moles of chromium trioxide reduced per glucose unit in the accessible region of the cellulose. Typical curves are shown in Fig. 1. This procedure was first applied to samples of a variety of commercial acetylation grade wood pulps and cotton linters. Results in Table I show a wide range of

Table I. Accessibility of Different Acetylation Grade Celluloses

Cotton linters pretreated with HOAc	*Moles CrO_3 consumed per g.u. by accessible portion*	*Wood pulp pretreated with HOAc*	*Moles CrO_3 consumed per g.u. by accessible portion*
Linters (swollen in 10% NaOH at 0°C.—2½ hr.)	0.31[a]		
		Source A	0.14
		Source B	0.12
Unswollen, dewaxed linters	0.003[a]	Source C	0.12
		Source D	0.11
Source A	0.09	Source E	0.09
Source B	0.08	Source F	0.07
Source C	0.07	Source G	0.05
Source D	0.06	Source H	0.04
Average	0.075	Average	0.095

[a] Glegg, R. E., *Text. Res. J.* 21:143 (1951).

Table II. Equilibrium Moisture Content and Chromium Trioxide Accessibility

Cotton linters			*Wood pulp*		
Sample	*Equilibrium H_2O, %*	*Accessibility in moles CrO_3/g.u.*	*Sample*	*Equilibrium H_2O, %*	*Accessibility in moles CrO_3/g.u.*
I	6.9	0.09	I	8.0	0.07
II	7.1	0.08	II	8.4	0.13
III	6.9	0.07	III	8.2	0.14
IV	7.0	0.07	IV	8.2	0.04
V	7.2	0.06	V	8.1	0.05
VI	7.2	0.07			

values for accessibility. The wood pulp samples, on the whole, show a higher chromium anhydride consumption or accessibility than the cotton linters. This observation is in agreement with the conclusions from other accessibility methods that wood pulps contain a larger percentage of amorphous material. On the other hand, the spread of values obtained with different samples of acetylation grade pulps is very wide, with two of the pulps consuming even less chromium trioxide than do the linters. There is some evidence that the low accessibility of certain wood pulp samples is associated with the use of a cold caustic purification process but there are insufficient data to permit any broad generalization.

The values obtained on linters swollen with acetic acid prior to oxidation are intermediate between those obtained by Glegg on unswollen and on intensively swollen linters. These data appear understandable in light of the findings of Richter and co-workers (*21*) as to the greater relative capacity of cellulose to absorb

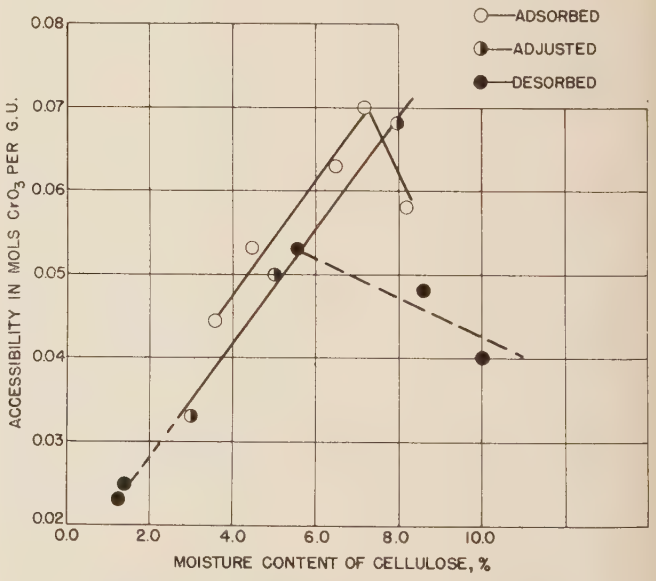

Fig. 2. Chromic oxide accessibility versus moisture content for cotton linters

water as compared to acetic acid, and the consequent effect on reactivity.

EQUILIBRIUM MOISTURE CONTENT AND CHROMIUM TRIOXIDE ABSORPTION

The equilibrium moisture content of certain of these celluloses was determined by the method of Howsmon (*14*).

Table III. Moisture History and Accessibility of Cotton Linters

% H_2O	Method of conditioning	Accessibility in moles CrO_3/g.u.
1.3	Desorption	0.023
1.4	Desorption	0.025
5.7	Desorption	0.053
8.6	Desorption	0.048
10.1	Desorption	0.040
3.6	Adsorption	0.045
4.5	Adsorption	0.053
5.0	Adsorption	0.050
6.5	Adsorption	0.063
7.2	Adsorption	0.070
8.2	Adsorption	0.058
3.0	Adjusted	0.033
5.0	Adjusted	0.050
8.0	Adjusted	0.068

Samples dried at 105°C. for 5 hr. were placed in a room maintained at 65% R.H. and 25°C. for 168 hr. The per cent moisture was calculated on the basis of the oven-dry sample weight. A control sample was run with each set of samples and its average moisture regain was determined. The deviation of the moisture regain of this control sample in each run from its average regain was applied as a correction factor to every result in the run.

The values obtained in this manner are given in Table II along with the accessibility in terms of moles of chromium trioxide per mole glucose for the same samples treated as described previously. There is no correlation between the moisture absorption of a cellulose and its consumption of chromium trioxide. The moisture absorption technique distinguishes between samples of wood pulp and cotton linters, with the wood pulp showing the higher moisture absorption. It does not indicate any differences among wood pulps from different suppliers where larger differences exist in the accessibility as determined by chromium trioxide

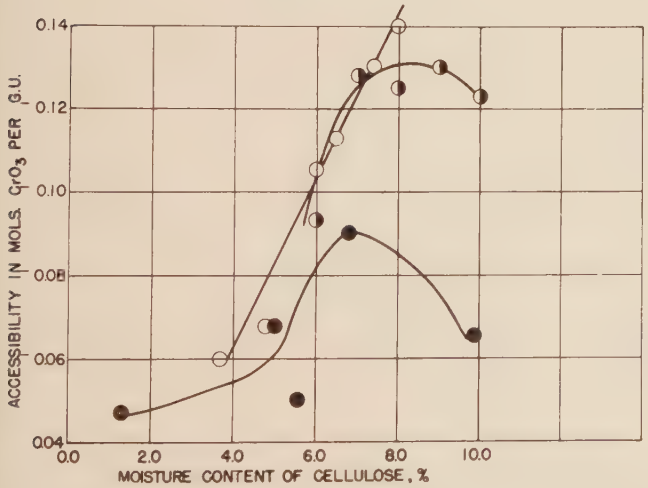

Fig. 3. Chromic oxide accessibility versus moisture content for wood pulp

○—adsorbed. ◑—adjusted. ●—desorbed.

oxidation. Since differences have been observed in the rates of acetylation of these various wood pulps it can be concluded that the accessibility, as measured by this moisture absorption technique, cannot be correlated with acetylation behavior. It remains to be seen whether a correlation exists between the chromium trioxide method and acetylation behavior.

It is suggested that the failure of the moisture absorption technique to relate to the accessibility of a cellulose for acetylation is due to the fact that the moisture absorption is influenced only by the ratio of amorphous to crystalline areas. The accessibility, as determined by oxidation, and esterification reactivity, is a measure not only of this ratio but also of the availability of the functional groups to the reagent and is affected by steric factors, impurities, and other characteristics of the cellulose.

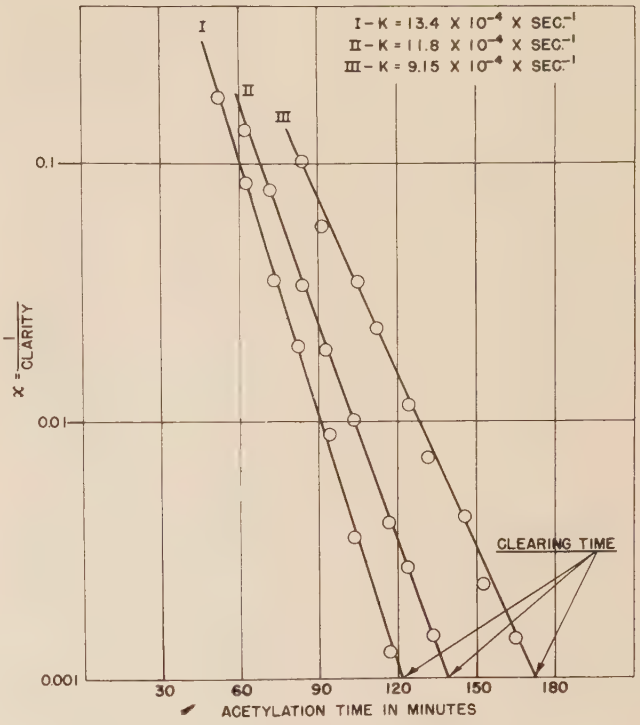

Fig. 4. Clearing rates for samples of wood pulp

MOISTURE HISTORY AND ACCESSIBILITY

It was shown in another series of experiments that the history of the cellulose is a factor affecting the

Table IV. Moisture History and Accessibility of Wood Pulp

% H_2O	Method of Conditioning	Accessibility in moles CrO_3/g.u.
1.3	Desorption	0.047
5.0	Desorption	0.068
5.6	Desorption	0.050
6.8	Desorption	0.090
9.9	Desorption	0.065
3.7	Adsorption	0.060
4.8	Adsorption	0.065
6.0	Adsorption	0.105
6.5	Adsorption	0.113
7.4	Adsorption	0.130
8.0	Adsorption	0.140
6.0	Adjusted	0.093
7.0	Adjusted	0.128
8.0	Adjusted	0.125
9.0	Adjusted	0.130
10.0	Adjusted	0.123

chromium trioxide consumption. Since work in our laboratories indicates that the rate of acetylation of a cellulose is related to its moisture content and the manner in which the moisture level has been attained (i.e., adsorption or desorption), it was proposed to

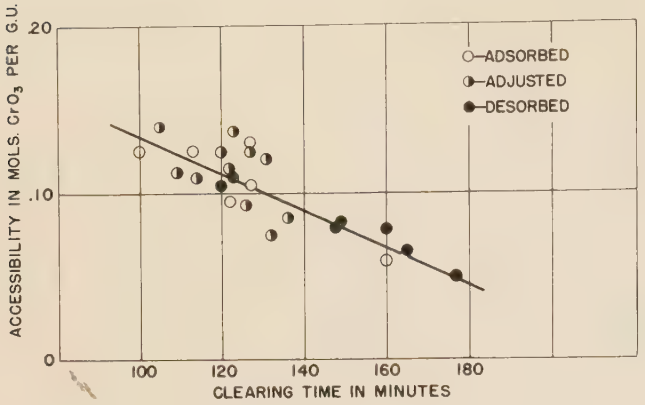

Fig. 5. Accessibility of celluloses versus their clearing time

determine the effect of moisture conditioning, prior to oxidation, on the accessibility as determined by the modified method of Glegg. Samples of cotton linters and of wood pulp, each from a single supplier, were used in this experiment, and were conditioned to varying moisture contents by the following procedures.

1. *Adsorption.* Portions of wood pulp and of cotton linters predried in an oven at 105°C. were conditioned to constant weight at room temperature in desiccators containing various saturated salt solutions, which provided relative humidities between 20 and 65%. Moisture content was calculated and accessibilities were then obtained after treatment with acetic acid and oxidation with chromium trioxide, as previously described.

2. *Desorption.* Thoroughly wetted cellulose samples were conditioned to constant weight in desiccators containing saturated salt solutions.

3. *Adjustment.* Samples dried to 1.0 to 1.5% moisture content were treated with acetic acid containing varying amounts of water prior to oxidation in the usual manner.

Tables III and IV show the effect of moisture content and moisture history on accessibility; these results are presented graphically in Figs. 2 and 3. These data show a marked difference in the accessibilities measured by chromium trioxide consumption among samples of the same cellulose at the same mois-

Table V. Accessibility and Acetylation Clearing Rate or Clearing Time for Various Celluloses

Sample	*% H_2O*	*Method of conditioning*	*Accessibility in moles CrO_3/g.u.*	*Acetylation clearing rate, sec.$^{-1}$ × 10^4*	*Acetylation clearing time, min.*
A	6.6	Adsorption	0.102	13.1	127
A	6.6	Desorption	0.082	10.5	149
A	9.0	Adsorption	0.125	14.5	100
A	9.4	Desorption	0.105	13.0	125
B-1	7.0	Adjusted	0.084	11.6	136
B-2	7.0	Adjusted	0.109	14.8	114
B-3	7.0	Adjusted	0.125	14.8	127
B-4	7.0	Adjusted	0.140	17.9	105

Table VI. Accessibility Versus Acetylation Clearing Rate and Clearing Time for a Single Pulp at Different Moisture Levels

% H_2O	*Method of conditioning*	*Accessibility in moles CrO_3/g.u.*	*Acetylation clearing rate, sec.$^{-1}$ × 10^4*	*Acetylation clearing time, min.*
1.8	Desorption	0.05	9.5	177
4.2	Adsorption	0.06	11.0	160
5.0	Adjustment	0.075	11.9	132
5.6	Desorption	0.066	9.5	165
6.0	Adsorption	0.095	14.2	122
6.6	Adsorption	0.102	13.1	127
6.6	Desorption	0.082	10.5	149
7.0	Adjustment	0.120	12.5	131
7.5	Adsorption	0.125	13.8	113
7.9	Desorption	0.080	11.0	148
8.0	Adjustment	0.130	13.5	127
8.9	Desorption	0.077	10.0	160
9.0	Adsorption	0.125	14.5	100
9.4	Desorption	0.105	13.0	125
10.0	Adjustment	0.125	14.8	120
10.1	Desorption	0.110	14.2	123

ture content, depending on the method of arriving at that moisture level. The cellulose which has reached its level of moisture by adsorption, in general, shows the higher accessibility. This is probably due to the fact, as suggested by Hermans (*13*), that junction points or areas of crystallinity form during drying or desorption and are broken during adsorption or swelling. The data suggest that the desorbed samples have formed more junction points at least in the outer layers of the fibers, and therefore, show a lower degree of accessibility.

ACCESSIBILITY VERSUS ESTERIFICATION RATE

While the data presented here show the variability among samples in chromium trioxide accessibility and the effect of variables such as cellulose source, method of purification, and moisture history on this property, the direct relationship of these differences to the usefulness of the pulp for acetylation purposes is not immediately apparent. Consequently, the rates of esterification of these pulps were determined in order to see if such a relationship could be established.

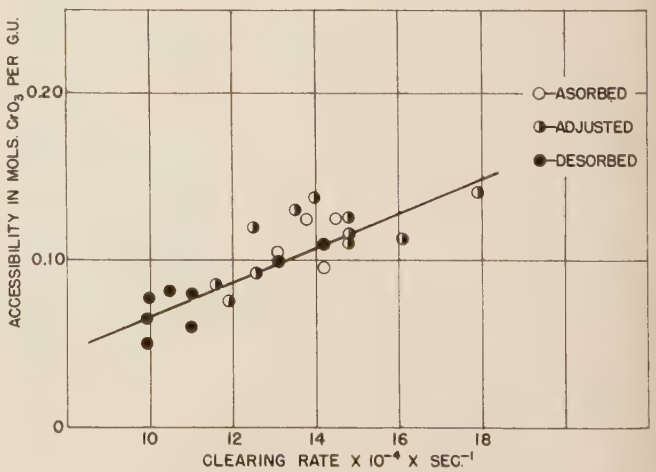

Fig. 6. Accessibility of celluloses versus their clearing rate

The procedure used for determining esterification rate is one developed in our laboratories, where the rate of clearing, or time of clearing, is used as a criterion.

The acetylation was carried out in an open 600-ml.

Table VII. Accessibility Versus Acetylation Clearing Rate and Clearing Time for Different Pulps with Same Moisture History (Adjusted to 7% H_2O)

Sample	*Accessibility in moles CrO_3/g.u.*	*Acetylation clearing rate, sec.$^{-1}$ × 10^4*	*Acetylation clearing time, min.*
A	0.084	11.6	136
B	0.137	14.0	123
C	0.093	12.6	126
D	0.109	14.8	114
E	0.125	14.8	127
F	0.113	16.1	109
G	0.118	14.8	122
H	0.140	17.9	105

Berzelius tall form beaker, immersed in a constant temperature bath maintained at 25° ± 0.1°C. A 10-gram sample of the cellulose was shaken for 2 hr. in a sealed jar with a mixture of 3.5 grams glacial acetic acid and 0.05 grams sulphuric acid, then stored for at least 18 hr. at 5°C. Acetic anhydride (60 grams), acetic acid (285 grams), and sulphuric acid (1.3 grams) were added to the swollen mass. A high speed, multiblade stainless steel stirrer was used for mixing. The initial temperatures of the acetylation liquor and pulp were so adjusted that the temperature of the acetylation mass never exceeded 25°C.

As the cellulose sample acetylates it dissolves in the reaction mixture. The progress of acetylation was followed by measuring 620 mmu light transmission through deaerated samples of the reaction mixture in a 10-mm. cuvette of a Lumetron photoelectric colorimeter, model 402E. Any unreacted and undissolved cellulose reduced the light transmission such that only a portion reached the photocell of the colorimeter. Moving the sample further from the photocell reduced the light reaching the photocell. Two light transmission readings were taken on each sample, one with the cuvette adjacent to the photocell (T_A), and the other with the cuvette 15.0 cm. from the photocell (T_B). It can be shown by a Beer-Lambert Law relationship that

$$\chi \alpha \log (T_A/T_B)$$

where χ is the concentration of undissolved cellulose particles. The acetylation was considered complete when log (T_A/T_B) became constant, i.e., no further decrease was observed. This minimum value, due to scattering from permanently unesterifiable bits, haze from acetic acid insoluble hemicellulose acetates, and imperfections in the cuvette was used as a blank correction. Corrected values of χ, considered proportional to the fraction of undissolved cellulose remaining at any time, were plotted on semilog paper as a function of time. Rates of clearing were calculated for each run from the slope of the straight line through the data points. The clearing time was arbitrarily defined as the time when χ equalled 0.001 (i.e., when χ intercepts the horizontal axis). Typical plots of χ are shown in Fig. 4. Clearing rates and clearing time for various samples of different moisture history are shown in Table V, along with their accessibilities as determined by the chromium trioxide method.

The relationship of accessibility to acetylation reactivity as measured by clearing rate or clearing time has been determined on a number of samples of the same cellulose at different moisture levels, attained by different means (adsorption, desorption, or "adjustment"). It has also been determined on a series of different pulps at the same moisture content, achieved by the same path. These results are shown in Tables VI and VII. In Fig. 5, accessibility has been plotted against clearing time and in Fig. 6 against clearing rate. It is apparent that there is an over-all relationship between accessibility measurements and acetylation rate which is independent of the moisture content or pulp source.

It is also apparent from these curves that measurement of accessibility by the chromium trioxide method on a given pulp will not predict its reactivity during acetylation under optimum conditions. It will only predict its behavior at a given moisture level when that moisture content has been approached by a known path. Measurement of esterification rate, by the procedure described above, is a simple and precise determination, which offers a far more satisfactory means for predicting acetylation behavior. The same qualifications apply here, however, as to moisture history of the sample.

Despite these limitations of the method, it has been established that the degree of swelling of the cellulose is an important consideration in attempting to use any chemical accessibility measurement to predict acetylation behavior. It might be postulated that, in general terms, any reaction rate measurement will suffice, provided the cellulose is swollen to the same degree as in acetylation. This almost certainly means that the cellulose must be moisture conditioned in an identical manner prior to both reactions and both must be carried out in essentially the same medium.

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Received May 2, 1955. Presented at the 40th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 21–24, 1955.

Chemical and Biochemical Effluent Purification

EDUARD FARBER and DONALD V. ROBERTSON

The general problems of water supply and stream improvement have become increasingly urgent. In this serious situation, it may be helpful to reconsider, in the light of recent experiences, the four avenues to a solution of the pulping waste liquor problem; (1) evaporation, (2) precipitation, (3) insolubilization, and (4) biological conversion. Special attention is recommended to the following possibilities: 1. New experiences in desalting sea water and in avoiding scale formation. 2. Combination of different kinds of effluents containing chemical precipitants for each other. 3. Reversal of the depolymerization of lignin in cooking. 4. Recovery of proteinaceous materials from the growing of selected microorganisms which convert dissolved lignin.

THE important role of water in agriculture and industry has recently found greater recognition because the supplies, formerly thought inexhaustible, are dangerously diminishing while the demands are growing.

"The Department of the Interior has announced that, according to the September records of the Geological Survey, a drought of major proportions comparable to the one experienced in the early 1930's is building up in the southern and central states. Ground-water levels, stream flow, and reservoir levels are at or near record low levels throughout the southern two thirds of the United States. Many communities and farms are short of water and some utilities and industries have been affected. The moderate floods that occurred in the northeast as a result of hurricane Edna did not appreciably alter the situation" (*1*).

Conferences have been held (*2*). At the 45th annual Western Forestry Conference in San Francisco, Secretary of the Interior Douglas McKay stated: "President Eisenhower considered the development of water resources so important that he established a cabinet committee on water resources policy which will report its findings early next year" (*3*). Local actions have been planned to find remedies. New emphasis is placed on the purification of industrial effluents. Our natural streams carrying less water, the load of impurities discharged into these streams must be reduced. Purification of effluents for re-use of the water becomes more necessary for general conservation, also more attractive from the economic point of view.

The industries of pulp and paper have been aware of these problems for many years. Many proposals and actual local solutions, some of them involving extensive installations, have been published (*4*). In the present survey, we attempt to show the place of our special problems in the broad general situation, hoping to gain new perspectives and evaluations which should lead to further advances of practical significance. Certainly re-appraisal is particularly necessary at a time when the general concern with stream pollution, in some places, has reached the dimension of hysteria. It is reported, for example, that after a company had bought a plant site it had been blamed for killing fish in a stream, although plant construction had not even begun at that time.

EDUARD FARBER, Chief Chemist, and DONALD V. ROBERTSON, Technologist Timber Engineering Co., Washington, D. C.

SEPARATION OF WATER AND SOLUTE

When water has to be recovered from a dilute solution there are two general methods of approach; one uses the difference in volatility between water and solute, the other relies upon converting the dissolved material into an insoluble precipitate.

Evaporation and Dialysis

The first method is used to concentrate the dissolved lignin compounds by evaporation. The cost of doing that is mainly carried by the lignin product obtained in the form of a syrup or, ultimately, of a dry powder. For the practice of this method, we should consider the development in the somewhat analogous field of obtaining potable water from the sea. The efforts in this field have recently been surveyed by Louis Koenig (*5*).

Several well-known principles have been, and are being, developed for increasing the efficiency in evaporating sea water. Multiple-effect evaporators require attention to the deposits on the heat-transferring walls. For sulphite liquors, the Rosenblad system provides a practical answer. The heat-pump applies thermodynamic principles to raise the temperature of the vapors for re-use and greater heat economy.

In addition, dialysis and ion exchange on membranes made from selected resins facilitate desalting of sea water. Dialysis with sulphite liquors has been extensively studied; practical applications, however, are at present not in sight.

Mutual Precipitation

Generally speaking, the removal of the dissolved material by precipitation appears to be more attractive than the removal of the very large proportion of water in costly equipment with the expenditure of a considerable amount of heat. Several years ago a method for combining sulphite pulp effluent and a proteinaceous residue from the manufacture of alcohol was described by E. Farber, G. D. Maengwyn-Davies, and J. S. Wallerstein. The salient and patented (*6*) feature here was the addition of lignosulphonate for precipitating protein substances in dilute solution.

This method was subsequently used by J. H. Hare and B. E. Baker for recovering protein values from whey. The precipitate was obtained at an optimal pH of 2 to 3. Preliminary feeding tests with rats showed that the lignosulphonate-protein material was well tolerated when it replaced 10% of the crude protein in the diet. A separation of the protein from the compound with lignosulphonate was not successful (*7*).

The method of combining liquors containing lignins and proteins could perhaps be extended to other effluents, of such nature that one purifies the other by precipitation. Such combinations would be of great value where the different kinds of effluents are available at the same place.

It is, therefore, of great interest to take a look at the many sources of dilute effluents from various industrial operations and their places of origin. Figure 1 shows locations of such main industries as mining and oil refining, metal working and sugar producing, dairying and pulping in the United States. Figure 2 is a close-up of Wisconsin, one of the most important states in pulp production. A more detailed study of these different kinds and locations of potential reagents for mutual purification may lead to further developments of general benefit.

Fig. 1

The map showing the locations of some sources of industrial pollution in the United States should not be considered as complete. A few industries have been chosen to illustrate the industrial wastes picture over the country.

A large number of diversified industries is found in the Puget Sound area, the mouth of the Columbia River, the San Francisco Bay and the Los Angeles area, the Great Lakes region, the Mississippi River, New England, the Central East Coast, and the Gulf Coast regions.

Symbols used on map:

C = coal fields
D = dairy products processing
M = metals, mining, and manufacture
O = oil wells and refineries
P = pulp and paper mills
T = textile mills

Each individual letter on the map does not represent a single manufacturing facility; the letters denote the general areas in which the facilities are to be found.

The information used in the preparation of this map was gathered mainly from the following sources: Bureau of Agricultural Economics, U. S. Department of Agriculture; Colby, Charles C., and Foster, Alice, "Economic Geography," Ginn & Co., Boston, 1947; "Commercial Atlas and Marketing Guide," Rand McNally, Skokie, Ill., 1952; Hodge, Willard W., "Waste Disposal Problems in the Coal Mining Industry," in Rudolfs, E., ed. Industrial Wastes, A.C.S. Monograph No. 118, Reinhold, New York, 1953; Thomas' "Register of American Manufacturers," 1952.

An example of purifying and effluent by means of the by-product of another operation has been described by A. Anable and R. P. Kite (*8*). They show a picture from part of the effluent treatment of Calco Div., American Cyanamid Corp., where 20 million g.p.d. are processed. The neutralization step there uses calcium carbonate obtained as a by-product in a nearby Johns-Manville plant. Although this example seems very simple compared with sulphite liquor problems, diligent search may turn up similar possibilities at least in some selected locations.

One of the difficulties connected with the purification of sulphite pulp effluent and protein-containing liquors resides in the fact that a relatively high degree of acidity is required to obtain complete precipitation. However, it is possible that the value of the precipitate, even if only as a fertilizer, would more than compensate for the costs involved.

Precipitation of Lignin by Autocondensation Under Heat and Pressure

While mutual precipitation of chemically different liquors is carried out at relatively low temperatures, precipitation by heating the sulphite liquor to high temperatures under pressure can be carried out without precipitants, or it can be achieved with the aid of mineral substances of low cost.

It has been known for a long time that the lignin substances of sulphite spent liquor are decomposed and, at least in part, converted into insoluble materials by heating to temperatures of 170 to 200°C. Methods of using this behavior of sulphite spent liquor are the subject of several patents; one of the first being German patent 341,857, priority of May 12, 1919, issued Oct. 10, 1921.

Pressure cooking of sulphite liquor has been modified by addition of salts like magnesium chloride which H. Schwalbe recommended, or of alkalies like the lime specified in German patent 709,943, issued Aug. 30, 1941, to H. Suida and V. Prey. This alkaline heating has been combined with supplying oxygen for partial combustion, as in K. Freudenberg's Norwegian patent 68,407, of Oct. 16, 1944.

Fig. 2

In reports from the National Council for Stream Improvement, it has been stated that the method of precipitation by heating under pressure has been studied on a pilot-plant scale. Details of the results have not become generally known. Apparently, these efforts have not led to any commercial application. Some of the difficulties involved in such a treatment can be readily understood; however, recent advances in methods and equipment for heat transfer and heat exchange could probably be applied with advantage, and the thermal decomposition could possibly be carried out in such a manner that salable products are produced.

Wet Combustion

A special modification of this approach has recently been patented by F. J. Zimmermann (*9*). "A flameless combination of oxygen with organic material in the presence of the liquid of the waste effluent, with the production of a useful amount of heat energy—" is contemplated. For example, sulphite liquor heated to a temperature of about 500°F. was treated at a rate of 78 gal. per hr., while 400 lb. of air per hr. at 1500 p.s.i. were introduced. Sufficient lime was added to precipitate the sulphur compounds as calcium sulphate. Although such a flameless combustion in the presence of all the water of the liquor may be a new approach, the economics of this particular process appear very doubtful.

An improved procedure has recently been described by E. W. Schoeffel (*10*). The oxidation of the organic materials in the sulphite liquor is there initiated with heated air under pressure and then becomes self-sustaining. Calcium bisulphite is recovered as the cooking liquor.

Hammermill Paper Co. has reported satisfactory pilot plant runs on a large scale.

Results of T. N. Kleinert's work on the heat precipitation of sulphite spent liquor at temperatures between 150° to 300°C. have recently been generally described (*11*).

MICROORGANISMS AS OXIDANTS AND AS CONVERTERS

Biochemical and biological methods in effluent purification and utilization are particularly intriguing. R. C. Kroner and W. Allan Moore found that biological decomposition of effluents in river water is very slow and incomplete (*12*). However, in biological treatment of mild effluents, in which bacteria, nutrients, and air are supplied, a sufficiently rapid biological decomposition of the dissolved organic substances can be achieved. A large project of this kind is planned by the West Virginia Pulp & Paper Co. in the plant at Covington, Va. (*13*).

Effluents from the production of yeast, after using up the fermentable carbohydrates in sulphite liquor, should be particularly suited for biological removal of the residual lignin. In the treatment of petrochemical wastes by a biological process, E. R. Strong and R. Hatfield observed that the recirculation of effluents from this process was beneficial. This was attributed to the presence of enzymes in such treated effluents (*14*). Therefore, it can be expected that bioactive materials present in the effluents from yeast manufacture would facilitate the subsequent biological action on the lignin compounds. The nutrients supplied for the growth of yeast and present in residual quantities in the effluents would also be helpful.

In such biological treatment, the main purpose usually is to remove the organic impurities. Recovery or utilization of the organisms is, in most cases, not contemplated. Here may be an additional source of potential revenue from biological processes of effluent purification. An example for the possibilities in this direction is offered by recent attempts to grow algae on the organic material in city sewage (*15*).

A combination of sanitary sewage sludge with kraft mill effluents in biological oxidation has recently been described by Fred W. Bishop (*16*). Here again, as in the treatment of petrochemical wastes mentioned above, it was found that "when the clarified effluent from the accelerated process is added to larger volumes of raw waste, the oxidation rate of the mixture is greatly stimulated."

CONCLUSIONS AND RECOMMENDATIONS

This brief review of recent developments is here offered in the conviction that, sometimes, hints for the solution to an urgent problem can be found in previous studies or can be concluded from older approaches. This conviction is nourished by such recent events as the success of insecticides based on chlorinated aromatic substances. Chlorinated benzol was known since Faraday's early work, and the chemical now designated as DDT lay dormant since the end of the last century.

From the foregoing report, we can conclude that four previously and presently studied methods can lead to recommendations for intensified attack on the pulping effluent problems: (1) desalting of sea water, (2) mutual precipitation of different effluents, (3) precipitation by heating, and (4) biochemical treatments.

Analogies in the Desalting of Sea Water

Present studies on the distillation of sea water may offer opportunities of taking a new look at methods for concentrating waste liquors. Work at E. H¨gglund's institute (*17*) stimulates an approach to the problem of scale formation by causing the calcium salts to precipitate before the liquor is introduced into the evaporators. Thermodynamic calculation, and utilization of the surface tension properties could lead to more economic methods.

Dialysis may appear expensive unless it were combined with an economical recovery of useful products. Methods of ion exchange deserve new scrutiny, since so many exchange resins have become available.

Mutual Precipitation of Different Effluents

Among possible combinations with sulphite spent liquors are acid sludge from oil refining, coal fines, heavy metals, and protein-containing effluents. These first named will need fundamental studies. In general, the problem of bringing appropriate effluents together may restrict practical applications to a few localities. Preliminary enrichment of one of the effluents may be worth considering; it would still reduce the combined costs for improving both effluents.

Precipitation by Heating

A primary problem here would be to keep the precipitate sufficiently dispersed so that it could easily be

removed from the heating zone to a settling or filtering station. The heat-transferring surfaces should thus be kept free of deposits. The materials used for transferring the heat will require special study. Basically, for example with regard to catalysts and uses, it may be helpful to compare the change to an insoluble product with the conversion of a soluble form of a synthetic resin into its final stage of condensation.

Biochemical Treatments

Many lignin-consuming microorganisms are known. Studies initiated by S. Gottlieb, continued by M. J. Pelczar and his associates (*18*) may give new leads to practical applications of biological treatments. Mineral nutrients, needed for the growth of organisms, may at least in part be found in by-products of other manufacturing processes.

Sometimes, this emphasis on wastes and discards from plant operations sounds as if it were slightly below the dignity of a respectable enterprise. Any feelings of this kind may be alleviated by remembering that most of our thriving fertilizer industries started as scavengers; for a long time potassium salts were dumped on the waste heap until better knowledge proved their value as plant nutrients.

The authors assume and hope that work in any of these directions is at present going on in some places and is still in the predisclosure state. They have tried to point out that much basic information is available. Whether, on this basis, technical processes can be developed, may find a more positive answer today than was possible only a few years ago. The technical and the economical background has changed. Today it pays to recover sodium sulphate from rayon spinning solutions (*19*) which, a short time ago, would have sounded just like one of those theorist's dreams.

In our industrial operations much attention has been given to the use and economy of heat long before it was realized that water cannot just be taken for granted. To the historian of chemistry, this sequence of events is not new. He can point out that the study of heat preceded that of water. Generally speaking, water remained the most neglected of the old four elements. The great revolution in chemistry was connected with new chemical insight into the "nature" of water. Today we are, sometimes quite painfully, reminded that water is one of our most valuable resources. Perhaps we may continue the historical analogy and hope that a new great advance in chemistry and industry will reward us for the new approach to the water problem, as it did in science some 175 years ago.

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Interpretation of Cooking Charts from Direct Steamed Kraft Digesters

JOHN MORRIS

A study of the internal conditions prevailing during direct cooking of kraft digesters is presented. Evidence is shown that the temperature and pressure at the top of a digester are not necessarily indicative of the average cooking conditions. A method is developed for scoring and comparing cooking charts from digesters. Inferences are drawn as to the patterns of internal flow during the cooking cycle.

Digester cooking charts are the quickest means of judging the quality of the cooking process. They are invaluable operating guides. They give a general indication of the quality of the pulp produced by showing whether it was cooked in the normal way or whether it was subjected to abnormally low pressure or temperatures. When a record is made of temperatures in the lower parts of the digester, as well as at the top, these uses can be extended. Evaluations of equipment changes and changes in operating procedure can be made and the manner in which liquor circulates in direct steamed digesters can be surmised.

Before the temperatures in various parts of a digester can be used as a measure of the quality of the cooking process, it is necessary to assume that the degree of cooking depends upon the cooking temperature. This is in accord with the researches of Hagglund and Hedlund. They found that the required cooking time could be halved for each 18°F. rise in temperature to

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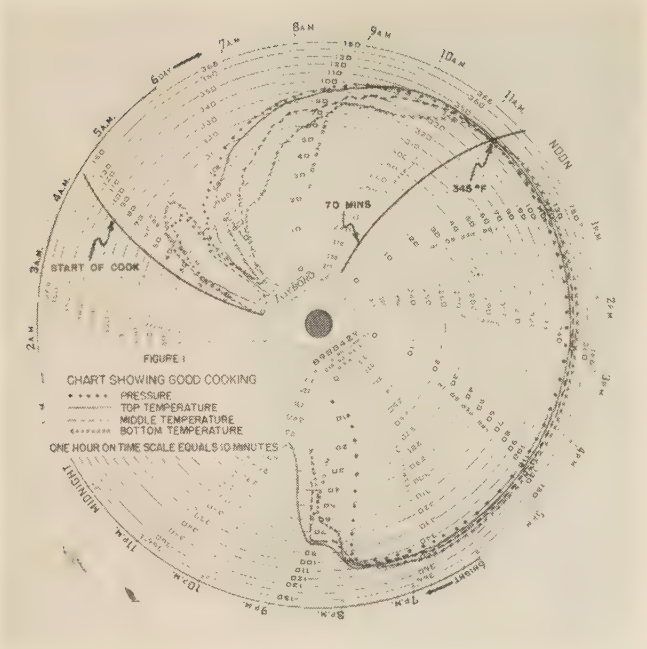

Fig. 1. Chart showing good cooking

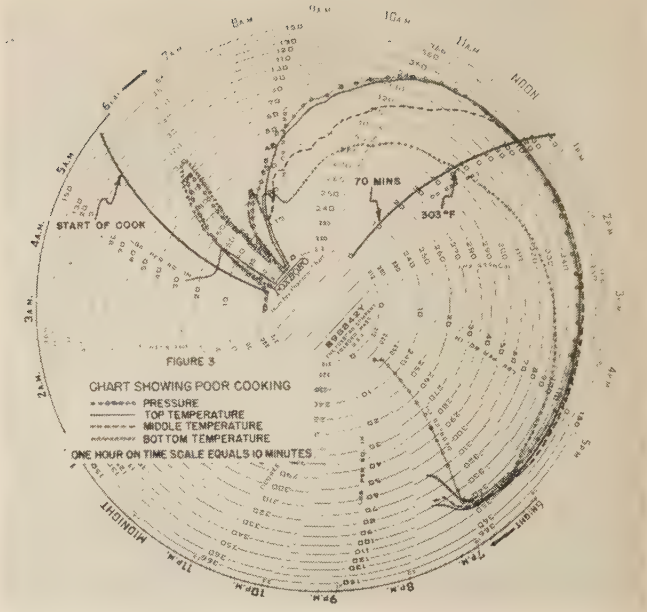

Fig. 3. Chart showing poor cooking

give approximately equivalent yield and lignin content. Conversely if the temperature falls 18°F., the required cooking time is doubled. The basic assumption will be made then, that if the temperature in any part of a digester does not rise promptly to its operating value, the chips in that part of the digester are not properly cooked and the quality of the cooking process is impaired.

IMPORTANCE OF RECORDING THE TEMPERATURES OF THE LOWER PARTS OF A DIGESTER

With this basic assumption, we are now in a position to examine several actual cooking charts. These charts will illustrate the importance of recording not only the temperature at the top of the digester, but also the temperatures at points lower down in the digester. To have a basis for comparison, a chart of a normal cook is illustrated in Fig. 1. This chart, as well as the other charts shown, was made by a multipoint recorder equipped with a 4-hr. chart drive instead of the usual 24-hr. chart drive. The faster chart drive makes it possible to distinguish relatively rapid variations in temperature and pressure which would not be observable if a standard 24-hr. drive were used. Each hourly division printed on the chart actually represents 10 min. The variables recorded are pressure, temperature at the top of the digester, temperature at the middle of the digester, and temperature at the bottom of the digester. The locations of the three temperature bulbs and of the pressure take-off are shown in Fig. 2. This figure also

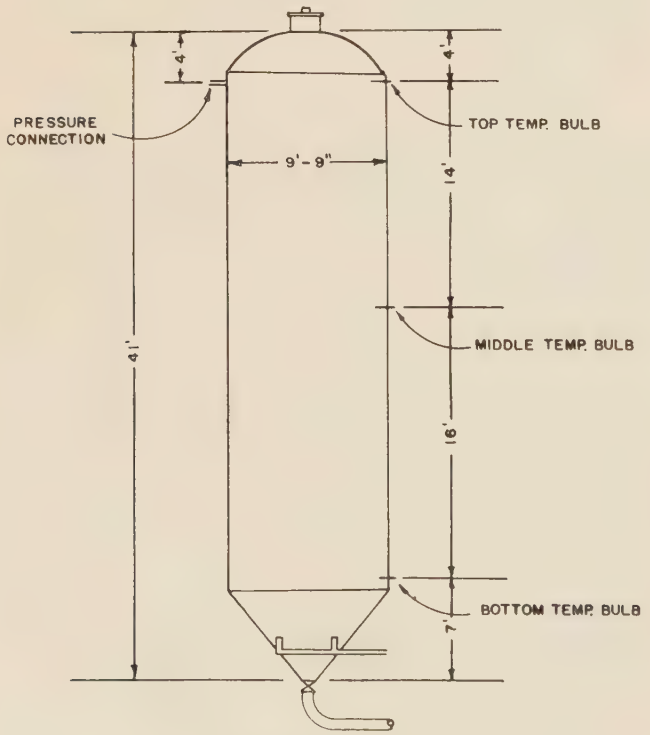

Fig. 2. Details of digester

Capacity of digester 2730 cu. ft.

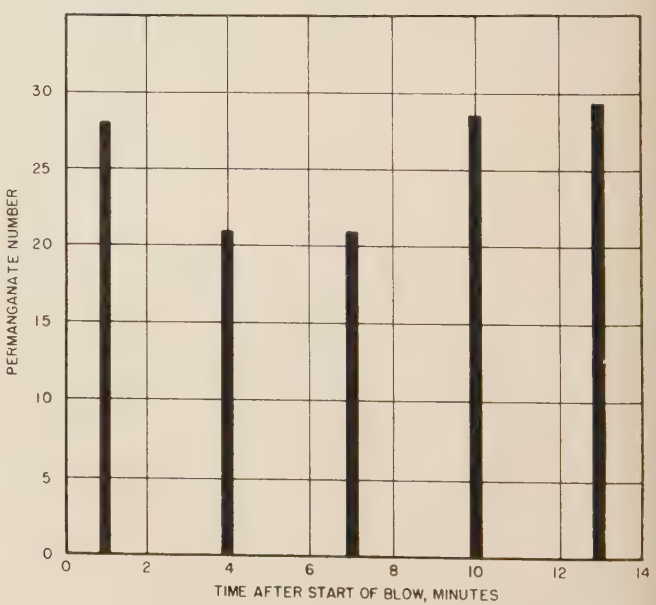

Fig. 4. Permanganate numbers of five samples from the same blow

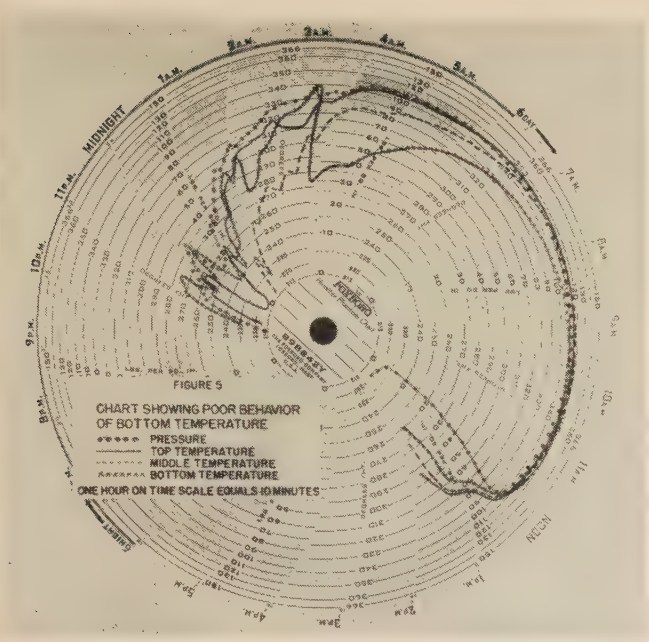

Fig. 5. Chart showing poor behavior of bottom temperature

gives the dimensions of the digesters under consideration.

Returning to Fig. 1, it can be seen that after an initial disturbance the three temperatures rise fairly uniformly and arrive at cooking temperature shortly after the digester has come to pressure. This represents satisfactory cooking since all the pulp was cooked at approximately the same temperature. A case of definitely unsatisfactory cooking is shown in Fig. 3. Here the bottom temperature did not rise promptly to its operating value; in fact, the bottom of the digester did not reach its proper cooking temperature until 10 min. before the digester was blown. During the time that the digester was on pressure, the temperature at the bottom of the digester averaged 323°F., 25°F. below its normal value. If the findings of Hagglund and Hedlund apply, the chips at the bottom of the digester were cooked less than half as much as those at the top.

Further evidence of the fact that this type of nonuniformity occurs in digesters can be obtained by taking a number of samples from a blow and determining the permanganate numbers of the various samples. This has been done, and it has been found that the permanganate numbers of samples from the same blow may vary over 8 units. The results of one of these tests are shown in Fig. 4. Samples were taken 1, 4, 7, 10, and 13 min. after the start of the blow. The difference between the highest and lowest permanganate numbers was 8.5. The figure shows definitely that the pulp from this cook was not uniform. Although Figs. 3 and 4 do not represent the same cook, it seems reasonable to ascribe variations in permanganate number such as those of Fig. 4 to variations in temperature of the various parts of the digester such as those shown in Fig. 3. An important point to note is that in Fig. 3 there is no indication from the pressure and top temperature that the cook was not progressing satisfactorily. There was no false pressure, except during the initial part of the cook, and the pressure and top temperature both came to their operating values evenly and on time.

Further illustration of the fact that the top temperature and pressure do not tell the whole story is given in Figs. 5 and 6. In Fig. 5 the cook progressed quite satisfactorily for the first 40 min. The three temperatures behaved erratically but they were all coming up. At about 45 min., from the start of the cook, a false pressure developed. To correct this, the digester was blown back, as shown by the pip in the pressure line. The false pressure was corrected but during the next 3 min. the bottom temperature dropped 64°F. and did not climb back to its correct value until 1 hr. later. This chart illustrates two things. The first is, again, that the top temperature and pressure do not tell the full story. As judged from the top temperature and pressure alone, the blow-back cured the trouble and the cook was entirely satisfactory from then on. The second point illustrated is that a blow-back based on temperature pressure differential is not always beneficial in correcting trouble in a digester.

Figure 6 shows another instance of poor conditions in a digester which would not be suspected if top temperature and pressure alone were observed. Here 15 min. after the digester reached pressure and the bottom temperature also was at its correct value, the bottom temperature started dropping and in 10 min. was 30°F. below its proper value. Following this, the bottom temperature made a fairly quick recovery and was below its operating point for only about 20 min. The chart is shown to illustrate the fact that not only during the pressure rise period but at any time during the cook there may be abnormal conditions in the lower parts of a digester which are not reflected in the pressure and top temperature.

THE USE OF DIGESTER COOKING CHARTS FOR COMPARING DIGESTER PERFORMANCE AND FOR EVALUATING EQUIPMENT CHANGES AND CHANGES IN OPERATING PROCEDURE

Digester cooking charts can be used to evaluate changes in equipment and changes in operating procedures. If, for example, a change in the method of charging digesters or a change in the steam nozzles is being

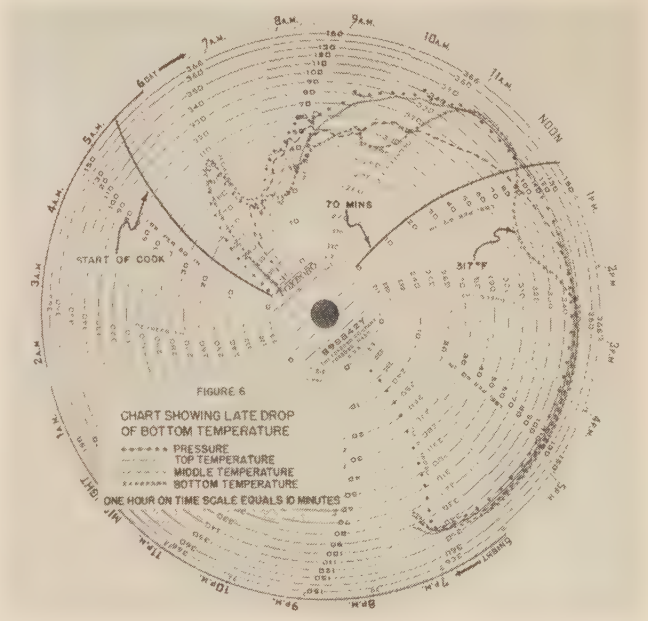

Fig. 6. Chart showing late drop of bottom temperature

contemplated, cooking charts can be used to indicate whether or not the change is beneficial. They can also be used to compare the performance of different digesters operated under the same conditions. In order to use the charts for comparative purposes, it is advantageous to be able to express the temperature variations in terms of a single number so that relatively large numbers of charts can be easily compared. This has been done by rating each chart according to the lowest temperature that existed in the digester at any time after 70 min. after the beginning of the cook. It is recognized that this method is not entirely valid because it takes no account of the length of time that a temperature is low. It has been used, however, because no better quick and easy method has been found.

The method of grading charts is illustrated in Figs. 1, 3, and 6. In Fig. 1 two time arcs are drawn, one at the start of the cook and one 70 min. after the start of the cook. The lowest of the three temperatures, top, middle, and bottom, intersects the 70-min. arc at a temperature of 345°F. At no time after 70 min. does any temperature fall below this value. The chart is scored 345. In Fig. 3 the arc at 70 min. intersects the bottom temperature line at a value of 303°F. and at no time later does a temperature fall below 303°F. This chart is scored 303. In Fig. 6 the 70-min. arc intersects the middle temperature at 330°F. but 13 min. later the bottom temperature drops to 317°F. This chart is rated 317.

A series of charts from a single digester operated under the same conditions shows great variation from one chart to the next. It is, therefore, impossible to get reliable information from a few charts. If 25 or more charts are graded in the manner shown and the scores averaged this average gives a fairly reliable index of operating conditions during that time.

An example of how this method of scoring can be used is given in a test made to evaluate two alternate operating conditions. The test was performed by installing 4-hr. chart drives in the temperature pressure recorders of two digesters. A series of charts was obtained, graded, and averaged for each of the two conditions. The results, given in Table I, showed that condition B was preferable to condition A. Condition B had a higher score for both digesters and gave increases of 4.1 and 8.4°F. in the averages of the lowest temperatures after 70 min. after the start of the cook. Condition B should, therefore, produce more uniform pulp.

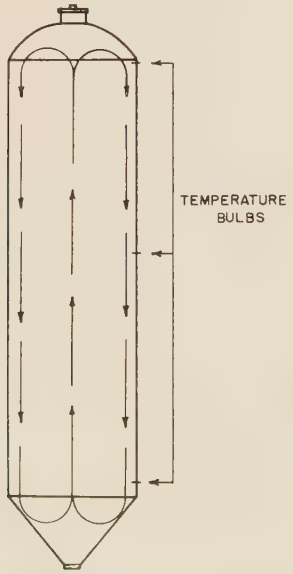

Fig. 7. Good liquor circulation

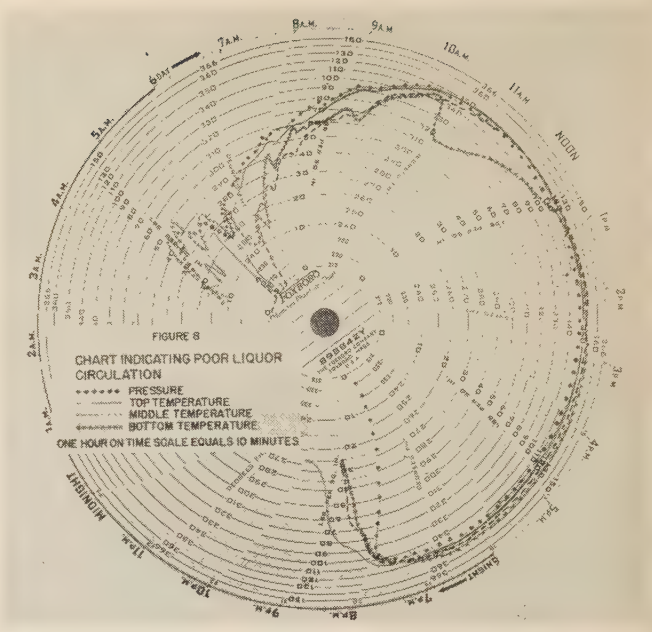

Fig. 8. Chart indicating poor liquor circulation

Table I. Comparison of Two Operating Conditions

Digester no.	*Condition*	*Number of charts graded*	*Average score, °F.*
9	A	52	338.8
9	B	51	342.9
		Increase	4.1
16	A	55	330.4
16	B	54	338.8
		Increase	8.4

A further point to be noted in Table I is that the two digesters did not have the same average scores for either of the conditions. This was found to be generally true. When average scores of charts from 20 digesters made under normal operating conditions were compared, considerable variations were found. Scores ranged from a low of 330.4 to a high of 346.5. A perfect score is 348. The reasons for these differences in the scores of the digesters are not known.

USE OF CHARTS FOR SURMISING THE MANNER OF CIRCULATION OF LIQUOR IN A DIGESTER

Cooking charts are useful in inferring the action that takes place in direct steamed digesters. As an illustration of this use of the charts, possible ways in which liquor may circulate in a digester are considered. It is surmised that the natural tendency of circulation of liquor is up the center and down the sides as shown in Fig. 7. How this is inferred will be illustrated by Fig. 1. There are three distinct periods during a cooking cycle, each of which has its peculiar characteristics. The first is the initial period of about 15 min. characterized by a rapid rise and fall of pressure and bottom temperature. The second period is the pressure rise

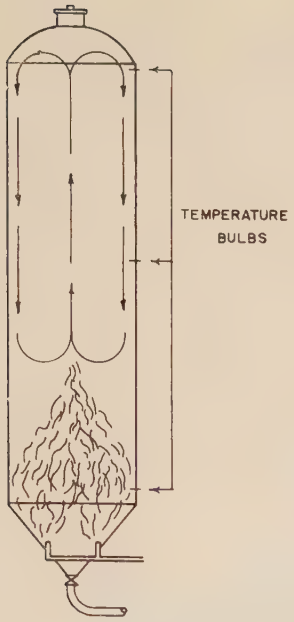

Fig. 9. Poor liquor circulation

period which lasts about 45 min. until the digester gets to pressure, and the final period is that part of the cook after the digester has come to pressure. The significant point to be observed is that during the pressure rise period, the temperature at the bottom of the digester is lowest, the middle next, and the top temperature is the highest. This is in direct opposition to the final period during which the bottom temperature is the highest, the middle next, and the top lowest, and to the initial period. The rapid rise and abrupt fall of the pressure and bottom temperature during the initial period is explained by the formation of a bubble of steam at the bottom of the digester and by its subsequent collapse. This is analogous to the flooding of a packed column. The temperature distribution during the final period is explained by the effects of hydrostatic head, the increased pressures at the positions of the lower bulbs resulting in higher equilibrium temperatures. The temperature distribution during the pressure rise period can be explained by the circulation pattern illustrated in Fig. 7. If this type of circulation did not exist, the

Fig. 10. Close-up of line

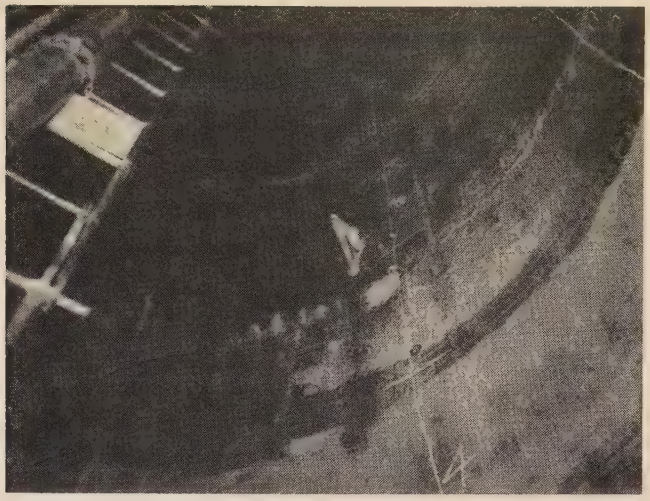

Fig. 11. View from bottom of digester showing location and extent of lines

bottom temperature would be the highest since it is nearest to the point of admission of the steam.

The preceding discussion and Figs. 1 and 7 show the natural manner of circulation of liquor in a digester and the type of temperature distribution associated with it. Figure 8 shows a cook in which another type of circulation exists. The significant point to observe is that during the pressure rise period, the temperature distribution in Fig. 8 is quite different from that in Fig. 1. In Fig. 8 the top and middle temperatures bear approximately the same relationship to each other as in Fig. 1. This indicates that the natural type of circulation, up the center and down the sides, is taking place in the top part of the digester. The bottom temperature, however, is generally above the middle temperature and is very erratic. This can be explained by the circulation pattern shown in Fig. 9. The four nozzles distribute the steam more or less evenly, depending upon their condition, over the bottom of the digester. This causes a region of turbulence in which the pattern of flow is unpredictable and erratic. The bottom temperature bulb located in this region is alternately in contact with steam or heated liquor and cooler liquor which accounts for its erratic behavior. Because of its proximity to the source of steam, it is on the average hotter than the middle temperature bulb. As the steam from the turbulent region ascends, it approaches the center of the digester and finally works into the natural manner of circulation. Thus, as is shown in Fig. 9, the natural pattern of circulation, up the center and down the sides, exists only in the top part of the digester, and in the lower part of the digester there is a region of turbulent and unpredictable flow.

Further evidence of the existence of this type of circulation has been obtained from observations of the appearance of the walls of digesters. Frequently the upper two thirds of the walls of a mild steel digester present an entirely different appearance from the lower third. This has been observed in eight digesters and in some instances has been most striking. In the case of one digester, the upper walls presented a bright shiny surface, looking and feeling much like the surface of a silver coin. This extended down to about 2 ft. below the middle temperature bulb where there was a very sharp line of demarcation. This line extended in an

irregular fashion entirely around the digester. Above it the wall was silvery; below it the wall was perfectly black, there being no intermediate gradation of color. A photograph of this line appears in Fig. 10. The black zone below the line was about 3 ft. wide and was bounded on the lower side by another line not as distinct. Below this line to the bottom of the digester the walls presented the appearance and feel of rusty iron. A photograph taken upward from the bottom of the digester is given in Fig. 11. This photograph shows well the location and extent of the two lines but is confusing because the lower rusty looking surface appears lighter than the upper silvery surface.

The explanation advanced for the existence of these lines around the digester is that they mark the point where the liquor coming down the sides of the digester meets the turbulent region and is turned back to flow again up the center.

CONCLUSION

In conclusion, the most important point brought out about digester cooking charts is that the top temperature and pressure do not tell the whole story. In order to get a reasonably complete picture of the cooking process, it is essential that temperatures in the lower parts of the digester be recorded. The second point is the use that can be made of the charts to evaluate changes in equipment or in operating procedure, and the third provides a basis for speculation as to what actually goes on inside of a digester.

Presented at the Eighth Alkaline Pulping Conference of the Technical Association of the Pulp and Paper Industry, Birmingham, Ala., Oct. 6–8, 1954.

A Method for Deaerating Coating Color

J. R. GUNNING

The trade is familiar with the results of entrained air in coating such as increased apparent viscosity, poor leveling, pits and pin holes in the resulting coat. Since the Deculator, designed by Rotareaed of Canada Ltd., effectively removes air from paper stock it was conceived that a similar apparatus might be practical for coatings. An agreement was reached whereby Rotareaed would design and construct an apparatus and Provincial Paper Ltd. would evaluate it. A stainless steel vessel was constructed and set up at Georgetown with the necessary auxiliary equipment of vacuum pumps, color pumps, and controls. Preliminary evaluations were carried out by cycling the coating in a closed system to show that there was no break down or harmful effects. It was established that air could be efficiently removed. The data obtained were used to redesign the equipment which was then installed on an air-knife coater. The results on the coated paper and machine operation are discussed.

The problem of entrapped air in coating color is familiar to all off-machine coaters. There has been a lot of work done on the problem and there are a great many supply houses who have products which they call defoamers. Some of these are quite effective but it stands to reason that if surface active materials are added to break foam they are liable to remain in the coating when it reaches the printer. Papers that are to be printed letterpress are not too critical from this point of view, providing they are not being used in a place where they have to resist handling by people who might have damp hands. With sheets that are to be lithographed however, the problem of wet rub or water repellency is to the fore from the very beginning, and it is not always possible to tell the customer that his men are running too much water on their offset presses. It would seem that the best thing to do is to leave out any surface active chemicals which might give trouble in this process.

The personnel at Provincial have evaluated a great many of the so-called defoamers that have been submitted by supply houses. A bubble column technique has been used which has given a reading of the amount of foam caused by allowing air to enter the column at the bottom and then the time that the foam lasts after the air has been shut off. Unfortunately the most effective defoamers have other drawbacks. As a secondary test to the bubble column the defoaming agent is added to a master batch of coating color and draw-downs made with a Warren laboratory knife coater. In a great many cases the really effective defoamers have caused grease spots in the finished coating when applied to paper.

A rational method of approaching the problem would seem to be to not put air into the coating when it is made. This has met with only very moderate success, and with production equipment which depends on Abbe high speed mills, the theory is completely destroyed.

The alternative procedure followed in our mill calls for several hours of gentle agitation to allow entrained air to be released before sending the color to the coaters. This system is moderately successful and the machine operators can instantly tell if they get "green" color. While we were thinking about this problem a meeting of the Niagara branch of the Canadian Pulp and Paper Association was held in St. Catharines, Ont. where C. L. Clark of Rotareaed Corp. gave a paper on the Deculator. This device was developed to remove the air attached to fiber in the paper stock going to the headbox of a paper machine.

Many will be familiar with this piece of apparatus since it is becoming fairly wide spread, but there may be some who have not come in contact with it, so a very brief résumé of its development will be given here. The name Deculator comes from the name of Judson A. Decew who is a Canadian paper chemist who specialized in treating paper fibers in the beater. He obtained his basic patent which covered spraying paper stuff into a vacuum to remove the air in about 1951. Prior to this in 1947 Clark and Vicario who were agents for vacuum pumps in the United States paper industry started work in an American laboratory to see if they

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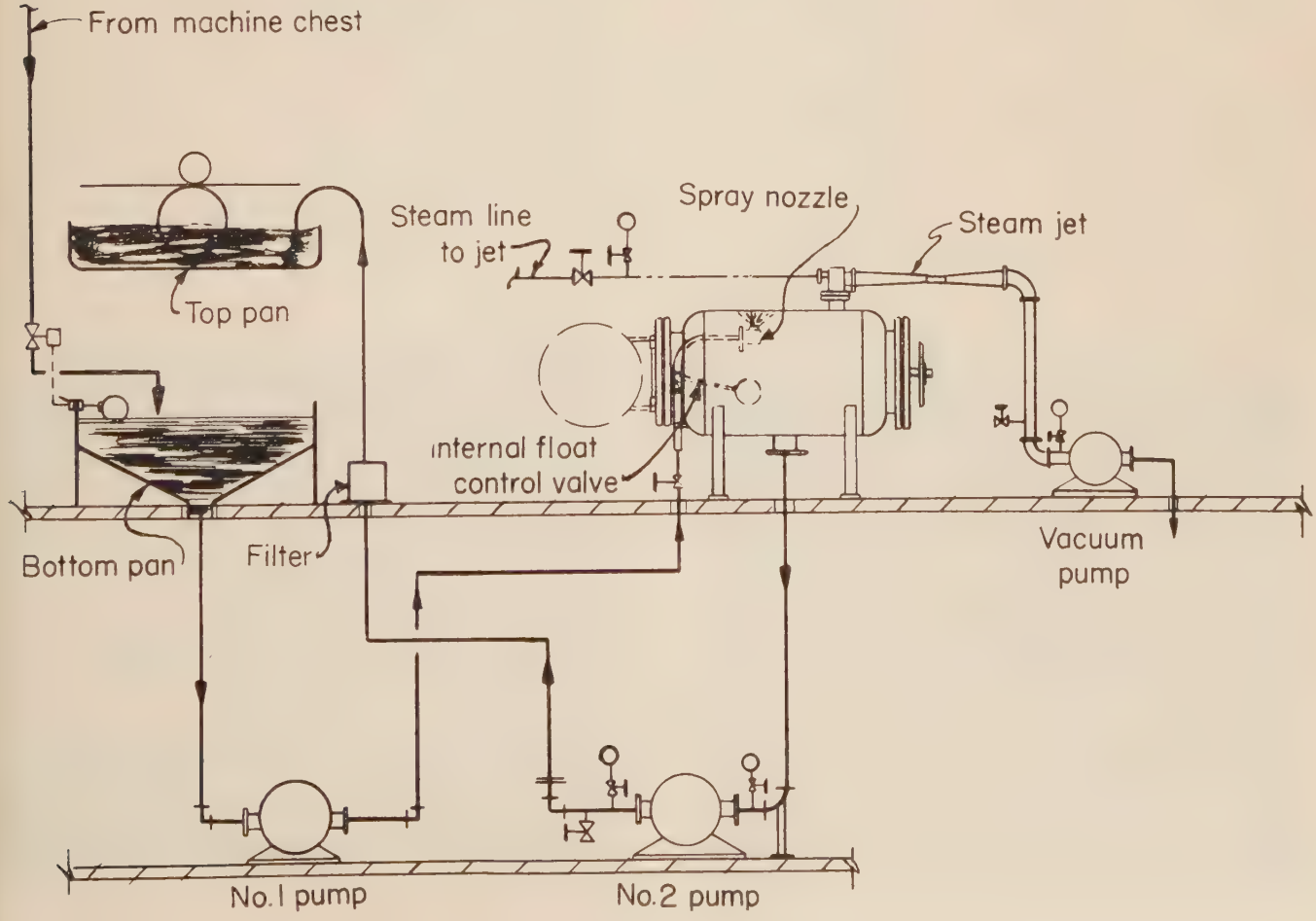
could develop a method of removing air from paper stuff. In 1948 work was continued in the laboratories of a Canadian paper company in conjunction with W. T. Bennett. They were seeking to treat the stock so that they would eliminate difficulties being experienced in the frozen flow head box. By 1950, using improved methods and the information obtained from Decew's patent the first commercial application of the Deculator was installed in a Canadian mill at Three Rivers, Que. The company, Rotareaed of Canada, Ltd., was formed at that time and since then there have been 50 to 60 installations in various places in North America. There is a corresponding corporation in the United States with headquarters at Bronxville, N. Y.

While the normal Deculator varies considerably in size, the quantity of material handled to supply the headbox of the paper machine is relatively large by the off-machine coater's standards. The regular installations are built to handle from 200 to 43,000 g.p.m., depending on the size of the paper machine. The approximate dimensions of these units therefore vary and run from 36 in. in diameter and 60 in. long to 72 in. in diameter and 40 ft. long.

The volume of coating color to be handled at the Georgetown mill for either of the coating machines equipped with Warren air brushes would be very much smaller than these figures. It was estimated that the volume of color to be treated would be in the neighborhood of 35 g.p.m. In December, 1952, J. A. Smith visited Georgetown and the possibility of doing a laboratory evaluation of the equipment was discussed. It was decided at that time that from previous experience it would be impractical to make a small unit and that a full-scale apparatus would be desirable. It was not until 1954 that preliminary details were cleared away and actual designs started on the equipment. A Deculator was designed by Rotareaed Corp. and fabricated by a shop in Montreal, Que. The unit was shipped to Georgetown, and evaluation was started in the fall of 1954.

Experience taught when handling paper stocks an absolute pressure corresponding to the boiling point was necessary in the receiver and the material had to be sprayed in at high velocity so that the air bubbles would be released. To obtain this high working vacuum a Nash pump was used in conjunction with a steam ejector. The normal design was to pull a vacuum on the receiver with the Nash pump and then using part of the paper stock as a condensing medium to increase this vacuum to the working range by condensing the steam from the ejector. The first receiver for coating color was designed and built on this principle and had a horizontal body approximately 24 in. in diameter and 36 in. long with a vertical section roughly 12 in. in diameter and 36 in. high. The steam ejector was attached near the top of the vertical section, and a portion of the coating color was sprayed into this chamber to act as a condensing medium.

The equipment was set up in the color preparation department with tanks so that the coating color could



Flow diagram of the Deculator process for coating color

Fig. 1

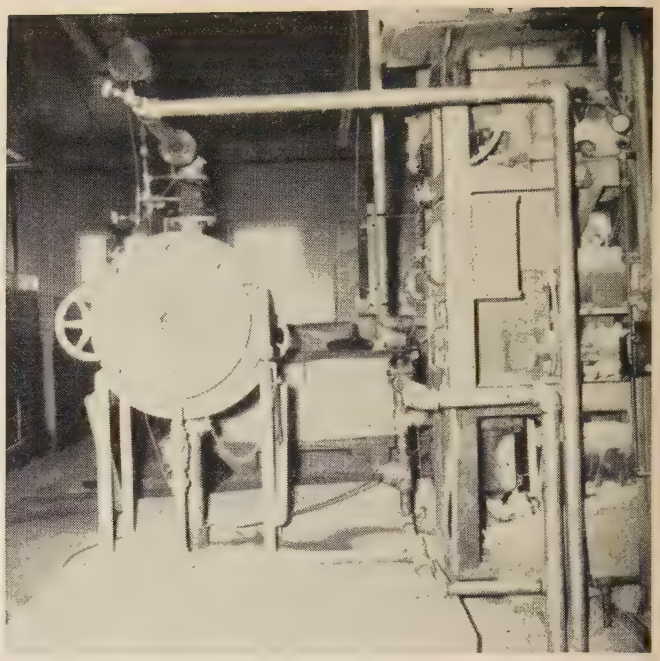


Fig. 3

Table I. Coating Color as Condensing Medium

Time of sample	*Specific gravity*	*Viscosity (200-g. wt.), sec.*	*Solids, %*	*Temperature, °F.*
	Color Entering Deculator			
10:00 a.m.	1.255	16.3	36.6	71
10:30 a.m.	1.225	7.7	32.4	79
11:05 a.m.	1.210	6.0	30.8	85
11:45 a.m.	1.195	5.9	29.4	88
12:30 p.m.	1.185	6.4	28.7	85
	Color Leaving Deculator			
10:00 a.m.	1.250	9.7	35.4	80.5
10:30 a.m.	1.220	6.6	32.0	79
11:05 a.m.	1.205	5.8	30.1	86.5
11:45 a.m.	1.190	5.5	28.8	89.6
12:30 a.m.	1.185	5.0	27.9	85

be circulated through the Deculator and back into the tank in a closed system. Several runs soon revealed that the addition of the condensate from the steam to the coating color was highly undesirable since it added a variable and the per cent solids and viscosity of the color progressively decreased.

The question will obviously be asked at this point why it was necessary to recycle the color through the Deculator more than once. Those that are familiar with the set up for a Warren air knife coater can readily understand the reasons, but a moment will be taken here to enlarge on them.

The arrangement which is believed to be quite common, is roughly as follows: there are two color pans on the coating machine referred to as the top and bottom color boxes. The supply line from the color preparation department comes to the machine and discharges into the bottom color box. The level is controlled by a float arrangement with a solenoid valve on the color line. A Moyno pump is situated below this box which draws color from it and cycles it through a Cuno filter and into the top box, in which rotates the applying roll. A surplus of color is supplied to the top box so that there is a constant overflow back into the

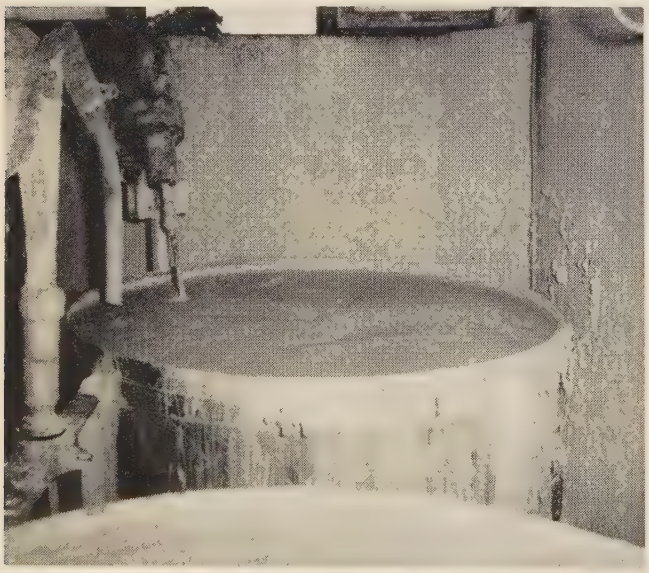


Fig. 2

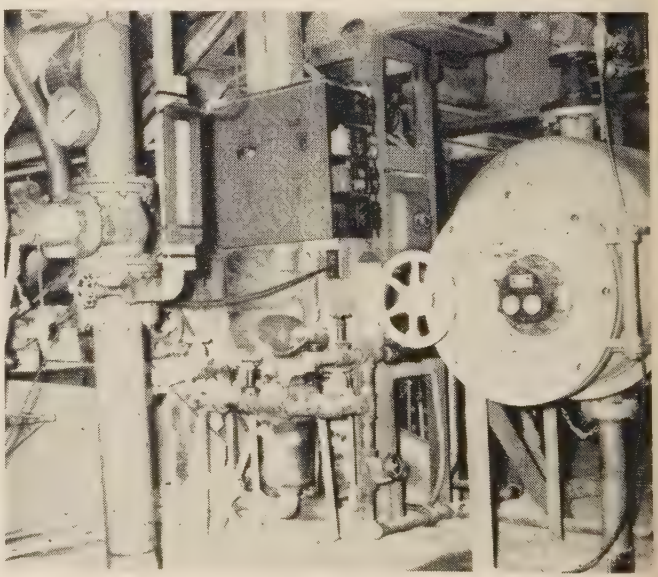


Fig. 4

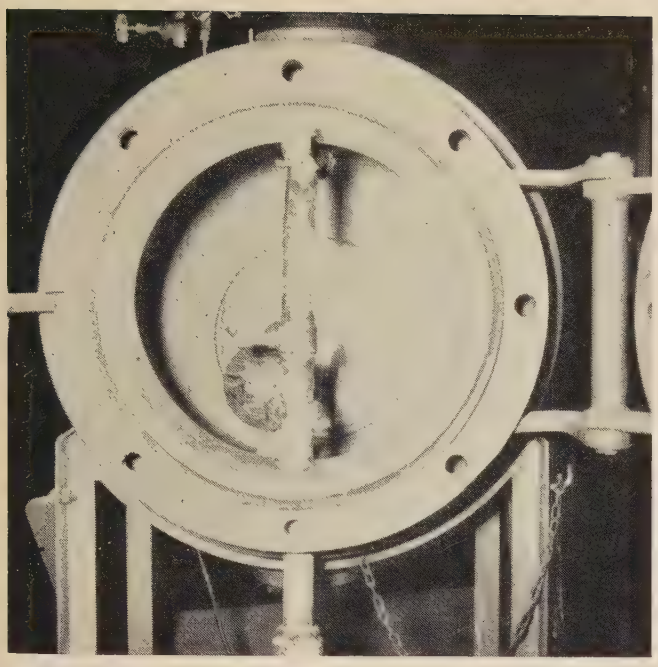


Fig. 5

lower box. The surplus color removed from the coated sheet by the air brush is also discharged into the lower box.

There are therefore several places where air can be entrapped in the coating color. There is quite a cascade where the supply empties into the box, there is considerable air entrapped in the material removed from the sheet which makes its way into the bottom box, and there is also an opportunity to pick up air when the overflow cascades from the top box. It was decided that the best place for a deaerating device would be in the supply to the top box so that the air introduced at the places mentioned above could be removed before the coating is applied to the paper. A study of the diagram will make the arrangement clear.

The first major change made to the setup was to divorce the steam ejector from the color system. The Nash vacuum pump requires 4 to 5 g.p.m. seal water so this water was used as the condensing medium. Good vacuum was obtained and Table II shows that the color was not diluted.

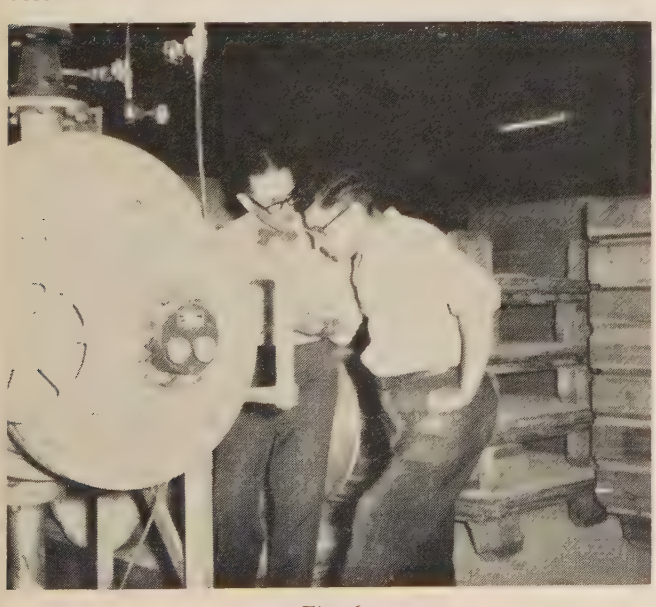


Fig. 6

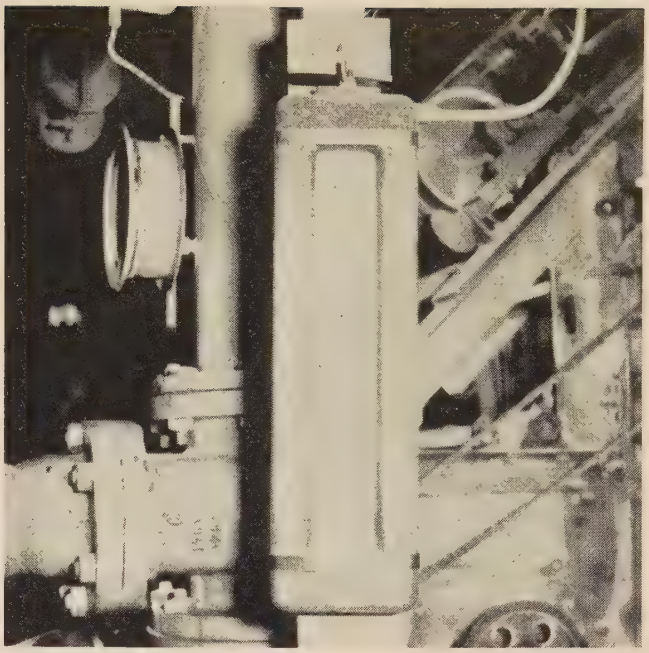


Fig. 7

Table II. Seal Water at Nash Pump as Condensing Medium

Time	*Per cent solids of coating* — *Color entering*	*Color leaving*
1:45	34.1	34.2
3:30	34.0	33.6
4:00	33.8	34.0
4:30	33.9	34.1

The trials carried out with the apparatus in the color department served to show a number of points as follows:

1. Coating color of various compositions can be sprayed successfully into a high vacuum and pumped without adversely affecting the coating. Most off-machine furnishes these days contain rubber latex of the styrene butadiene type. It was suspected that the high mechanical shear might cause the latex to coagulate but this did not prove to be the case.

2. Air was removed from the coating as evidenced by the increase in specific gravity.

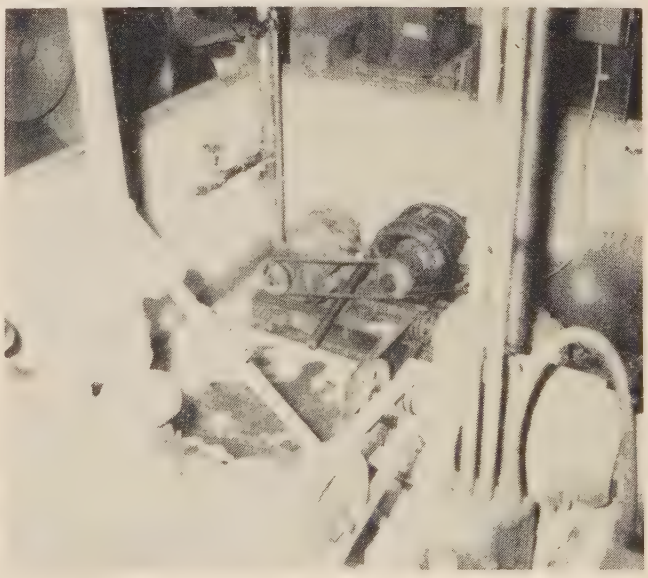


Fig. 8

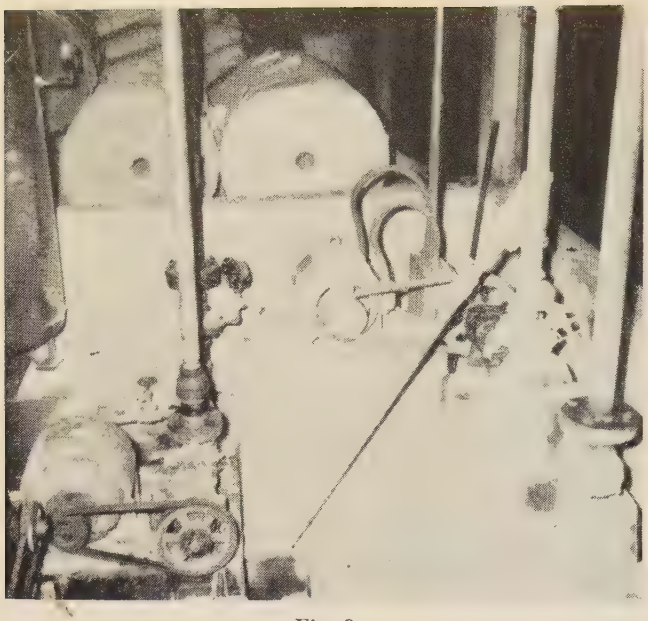


Fig. 9

3. Air was removed from the coating as shown by the lowering of the viscosity.

4. Air was removed from the coating by visual examination when the material was poured over a glass plate and examined for air bubbles with a glass.

5. The effective liquid level in the receiver must be held within fairly close tolerances for the following reasons: (a) if the level gets too low the Moyno pump begins pulsating and the deaerating effect is lost, and (b) if the level becomes too high foam is carried over by the steam ejector into the Nash pump.

Other points established with the first piece of apparatus were that the manholes should be large enough to permit easy access for washing up and the use of D.P. cells which require a water purge were not satisfactory. It was decided to redesign the equipment and build a new receiver. The new, redesigned Deculator was installed in the system for no. 2 coating machine and Figs. 1 to 15 illustrate the setup.

Fig. 10

Fig. 11

The grade that was running on the machine when the Deculator was ready to operate was a book sheet, coated two sides, using starch and latex as the adhesive with English china clay. The starch ratio to dry rubber was approximately 50-50 and about 15% adhesive was used. The specific gravity of the coating color on the supply side was 1.228 and after it had passed through the Deculator to the top box it was 1.255. The viscosity was measured with a Stormer instrument using the regular cup and bob at room temperature. The color temperature was 73°F. A 100-gram weight for 100 revolutions was used and readings of 13 sec. on the supply side and 11.5 sec. on the deaerating side were obtained. All evidence of foam and bubbles in the top box completely disappeared.

The grade running on the machine during the next trial was a litho sheet containing a small percentage of satin white and a casein-latex adhesive with a ratio of

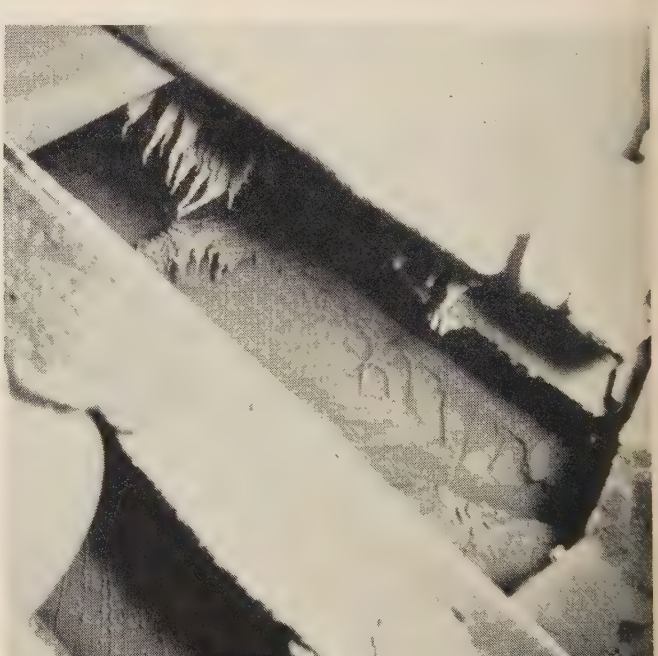


Fig. 12

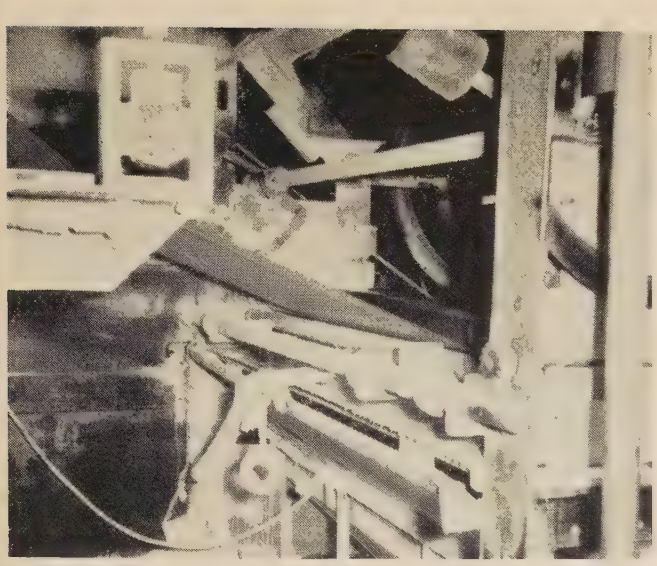


Fig. 13

Table III. Typical Instrument Readings

Absolute pressure in receiver	0.8 in. Hg
Vacuum at Nash pump (Bourdon gage)	26 in.
Vacuum at no. 2 Moyno pump (Bourdon gage)	17 in.
Steam pressure to ejector	95 p.s.i.
Barometric pressure	29.54 in. Hg
Air brush setting	1.5 p.s.i.
Coater speed	650 f.p.m.

about 1 part rubber to 3 parts casein. The change in specific gravity in this case was from 1.190 to 1.229. The corresponding viscosity readings were 16.4 and 14.5 sec.

Several rolls were coated for each trial and the finished paper after supercalendering was sampled and examined. With only the two trials carried out to date it would be presumptive to draw any conclusion, but the observations on these two trials are presented. There was very little difference to be seen in the book sheet with the starch-latex adhesive and the regular test results did not show any differences. The litho sheet on the other hand seemed to show a better filled surface and there was an obvious decrease in the number of air holes or pin holes when viewed under a binocular microscope.

Fig. 14

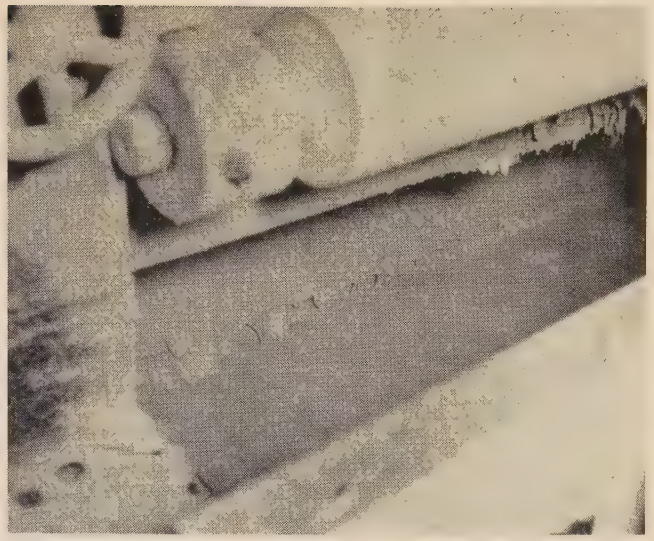


Fig. 15

The operators have always experienced a good deal of difficulty if the coating color is allowed to go to the coating machines without a sufficient interval for conditioning after the mixing operation. As has already been stated the color is allowed to rest in a fairly large tank under gentle agitation to work the entrapped air out of it. To give the Deculator the worst possible condition fresh color was supplied right out of the mill. Normally there would be 6 to 8 in. of foam on the bottom box and it would be cascading over the edge of the top box under these conditions. When the Deculator was cut in there was absolutely no sign of foam or bubbles in the top box and the blanket of foam in the bottom box was considerably less than anybody anticipated. While this is not a particularly scientific observation it secured the cooperation of the machine men since they dislike having foam splatter around the machine and then being criticized for their housekeeping.

No significant changes had to be made in setting of the controls of the coating machine when the Deculator was cut in. The air knife pressure was left the same at 1.5 p.s.i. The machine speed remained the same at 625 f.p.m. The dry end operator did not particularly notice any difference in the way the sheet reeled but he did state that he thought that the sheet felt smoother as it came over the hold-back of the winder.

There is still much work to be done before it can be said that development of this piece of equipment is complete but it appears that it is a useful piece of apparatus. It is planned to make a number of runs with the color being treated in this manner and again in the usual manner and comparing the printing results in various customers' print shops. The differences this color treatment produce are relatively hard to measure and it will probably be a case of massing data over a fairly long period of time before conclusions can be drawn with any safety.

RECEIVED June 20, 1955. Presented at the 6th Annual Coating Conference of the Technical Association of the Pulp and Paper Industry, Cleveland Ohio, May 23, 1955.

The author would like to express his thanks and appreciation to Messrs. Hicky and Smith and their staff of the Rotareaed Corp. for the engineering and all the help they have given us in the evaluation during these trials. He would also like to thank his own staff and particularly the mechanical staff which did such splendid work when they were asked for rush changes.

Inorganic Analytical Filter Paper

HANNS F. ARLEDTER

Cellulose analytical filter papers and membrane filters are compared with newer 100% inorganic filter paper developments in regard to retention of precipitates, flow of water, and wet bursting strength. A method to rate the retention of filter papers is outlined. Data in regard to chemical composition of inorganic filter papers, the chemical resistance, and other physical tests are given.

WHILE the employment of organic and inorganic synthetic fibers for papermaking was contemplated for the last 20 to 30 years, serious consideration in the manufacture of paper made of glass fibers, especially for air filters, started at the end of 1950 after Callinan, *et al.* (*1*) was successful in the manufacture of a paper made of 100% glass fibers. The Hurlbut Paper Co. research laboratory started to consider an inorganic fiber paper for analytical filters at the end of 1951, after the successful development of a new process which allowed the manufacture of 100% inorganic synthetic fiber papers made of glass, aluminum silicate, and silica and which yields products with good to fair wet strength in contact with water.

Considerable work has been done with glass fiber filters by Duval (*2*), and filter mats for Gooch crucibles have been recommended by Russell and Harley (*3*) and Ma and Benedetti-Pichler (*4*). It is the intention of this paper to outline some properties of the filter characteristics of the new organic analytical filter papers which are either on the market, or are products which look interesting as a future aid for analytical chemists.

GENERAL DESCRIPTION OF INORGANIC FIBERS

Chemical and physical properties of three binder-free synthetic inorganic fibers which were adapted for papermaking purposes are listed in Table I.

Glass fibers and ceramic fibers are commercially available in a wide range of different chemical compositions. Still more sub-micron fibers were successfully developed in the laboratory or pilot plant. Glass fibers containing lead up to 40%, copper oxide up to 23%, magnesium oxide up to 30%, cadmium oxide up to 30%, tin oxide up to 15%, silver oxide up to 10%, to mention a few, were developed and may be available if need arises. Glass fibers are produced now in a thickness range between 0.05 and 9 mu. The lower thickness limit for ceramic fibers is, at the moment, 1.3 to 1.5 mu. Silica fibers should be available in the glass fiber class of 0.2 to 1.5 mu, but these fibers are not completely satisfactory yet. More than 30 different ceramic or glass fibers have been tested so far, and successful paper has been made of most of them.

The melting or softening point of the inorganic fiber materials employed for papermaking can be varied between 570 up to 1600°C. Specific gravity of the fibers can vary between 2 and 4.5.

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GENERAL COMPARISON OF CELLULOSE FILTERS AND INORGANIC FILTERS

Principally, it was found that the cellulosic analytical filter grades 602, 597, and 604, manufactured by Hurlbut Paper Co., South Lee, Mass., listed in Table II, are somewhat representative in regard to the filter performance and other physical properties of the cellulosic filter grades manufactured by Whatman, England; Munktell, Sweden; and Schleicher & Schuell, United States, and Germany. The membrane filter (Lovell Chemical Co., Watertown, Mass.) should be typical for filters of organic film nature.

For the comparison in Table II, two aluminum silicate filter papers, three glass filter papers, and one silica filter paper developed by Hurlbut Paper Co., were selected.

The comparison of the filter characteristics, retention, and rapidity, reveals that inorganic analytical filters may be able to supplement cellulosic analytical filters for specific analytical applications but each of these materials may have advantages over the other for different working methods or different tests.

Retention Studies

The filter retentivity for precipitates or particles of varying size under varying working conditions is the most important feature the analytical chemist is concerned with in selecting the filter. The retentivity of the filter will decide what method of precipitation, or filtration can be employed.

The work dealt with the retentivity of cellulosic filters versus inorganic filters for the retention of hot and cold precipitated calcium oxalate, barium sulphate, lead sulphate, and ferric hydroxide under varying filtering conditions especially in regard to filtering under suction. As a good and easy over-all method to classify the retentivity of a filter, it was found that calcium oxalate, hot or cold precipitated, gave the most convenient approach. In using one, two, or three filter layers, filtering under no, slight, and strong suction and washing the precipitate, some system of filter rating in a wide range seems to be possible if the results in Table II are evaluated. Only the ultra filters (O-512-H and O-839-H) cannot be rated in this list.

As a result of this work inorganic filters were developed which yield, under all employed test conditions, hot or cold precipitates, low, medium, or strong suction, 100% retention of the above precipitates.

Federal Retention Test. There are three main groups of analytical cellulose filters designed for three different particle sizes to be filtered. These have to meet the Federal retention specifications UU-P-236a of: (1) 100% retention of hot precipitated barium sulphate for fine precipitates, (2) 100% retention of cold precipitated lead sulphate for medium precipitates, and (3) 100% retention of ferric hydroxide for coarse crystals and gelatinous precipitates. All the inorganic

Table I. Comparison of Inorganic Materials: Silica, Glass, and Aluminum Silicate

	Silica	*Aluminum silicate*	*Pyrex "E" glass*
SiO_2	97.8	49	53.4
Al_2O_3	..	49	15.5
CaO	..	..	16.3
B_2O	..	1	9.9
Na_2 (K)	..	0.5	4.7
Residue	2.2	..	..

filters show, in Table II, 100% retention for all three Federal retention tests.

Cone Retention for Cold Precipitated Calcium Oxalate. The following method has been used for many years to evaluate analytical filters, using cold precipitated calcium oxalate.

A filter disk of 11 cm. in diameter is folded to a cone and the disk free-hanging suspended with two clamps.

Ten milliliters of a solution containing 0.1 gram $(NH_4)_2C_2O_4$ is precipitated at room temperature, 20° C., with 20 ml. of a 1% solution of $CaCl_2$. Adding of the calcium chloride solution to the 10 ml. $(NH_4)_2C_2O_4$ in a 50-ml. Erlenmeyer flask and the time cycle in performing this test has to be standardized to obtain comparable and reproducible results. The filtrate is titrated with $N/10KMnO_4$.

The best cellulosic filter of group A yields a cold precipitated calcium oxalate retention of 98 to 99%, while the average for this filter group is 92%. Group B follows with a retention of 51 to 79% and group C yields 12 to 42% retention.

All the inorganic filter papers show, under the same conditions, 100% retention.

The retention of cold precipitated calcium oxalate proved to be a very severe test for the retentivity of analytical filters.

If the tests are performed under exact conditions, the results are reproducible.

Retention of Cold Precipitated Calcium Oxalate Under Varying Suction. The methods previously described allow classification of cellulose filters, but all inorganic filters have 100% retention and a method of classifying these filter grades also had to be found. It was found that the retention of cold or hot precipitated calcium oxalate under varying suction, using one, two, or three filter layers, allows the classifying of the filter retention performance, with the exception of ultra filters.

The test is performed in the following manner.

A vacuum pump is adjusted to vacuums of 1, 10, and 27 in. Hg. A 250-ml. flask is used. The calcium oxalate is filtered through a filter area of 9.2 sq. cm.

Filter 934-AH shows 100% retention without suction, 99.8% under 1 in. Hg vacuum, 69.9% at 10 in. Hg, and only 56.4% at 27 in. Hg. Glass filter paper O-512 shows, under the same conditions, 100% retention for all tests.

With one filter layer 934-AH shows 56.4% retention at 27 in. Hg vacuum suction, with two layers 99.4%, and with three layers 100% retention is obtained.

Three filter layers of the group A average cellulosic filter 602 yield only 25% retention.

Table II outlines, therefore, the safe retention limits for one, two, and three layers for different filters for varying degrees of suction to be employed Cellulosic filters of the tested nature do not allow filtering under suction for very fine or medium fine precipitates, while the ultra glass fiber filters can be used under most practical conditions of suction.

Retention Under Strong Suction and Washing the Precipitate. Under practical conditions washing of the precipitate is a prerequisite. Washing reduces the retentivity and the combination of a very strong suction and excessive washing proves to be the most severe retention test.

The best cellulose filter 602 retains only 4.5% of the cold precipitated calcium oxalate; glass filter 934-AH, recommended for its high retentivity, retains only 20%; while the glass ultra filters O-512 and O-859-H show a retention of 100% under this severe test at a theoretical liquid linear velocity of approximately 20 f.p.m. or less or 10.8 cm. per sec. or less.

It may be mentioned here that filter 934-AH is a very effective air filter which shows at an air filter speed of 10.5 f.p.m.; a DOP penetration rate of not more than 0.004% (retention: 99.996%); at 28 f.p.m., 0.01% or 99.99% retention for DOP particles of 0.27 mu diameter.

Retention of Hot Precipitated Calcium Oxalate. While the retention of cold precipitated calcium oxalate is a safe retention test designed for very effective filters for fine precipitates, hot precipitated calcium oxalate can be used to classify filter paper for medium precipitates. The test results for the retention for one and two layers at 27 in. Hg suction show again a superior retention performance for all inorganic filters in comparison with cellulosic filters. The filter rating of 602 is 82% and 970-FH 90.5%.

Filter Speed or Rapidity

To define the performance of a filter, the filter speed (rapidity or time of flow of water) is the main issue next to retention. Table II compares the rapidity or filter speed for cellulosic analytical and inorganic filter papers. The Federal Specification UU-P-236-a does not cover rating filter performance under suction or filter pressure. Therefore, two simple lab methods were used to make such tests.

Cone Rapidity. The time necessary to filter 10 ml. of water with a free hanging 11-cm. circle cone according to Federal Specification UU-P-236-a was determined for cellulosic analytical filters for fine precipitates. The time was 84 to 220 sec. for the varying filters of group A on the market. The fastest inorganic filter shows, in comparison, a rapidity of 2 to 4 sec. and the slowest inorganic filter only 47 sec.

The cone rapidity, without suction or pressure, deals with one method of filter application; filtering under pressure or suction is the other practical use. Some tests are shown in which the time to filter water under pressure or vacuum is recorded.

Rapidity (Distilled Water). This test was performed with a filter funnel with a filter area of 9.2 sq. cm. and a volume of 1200 ml. The vacuum pump was adjusted to 0, 1, 10, and 27 in. Hg. The rate of flow of liquids through filter paper may become progressively slower with continued flow (*5*). The use of prefiltered distilled water reduced these difficulties for our comparison. The filter time of ultra filter O-512-H is approximately $^1/_8$ in comparison with 602 or the membrane filter.

Filter Speed under 30 in. Water Pressure. The time

Table II. Filter Characteristics of Organic Analytical Filter Papers versus Inorganic Analytical Filter Papers

	100% Cellulose filter paper (rag or alpha-cellulose) (ash free or ash low)			*Cellulose acetate membrane filter*	*100% E-glass (100% ash)*				*100% Silica (100% ash) (98% SiO_2 + 2% residue)*	*100% Al-silicate (100% ash)*	
	HP 602	*HP 597*	*HP 604*		*HP 0-859-H*	*HP 0-512-H*	*HP 0-849-2H*	*HP 0-849-AH*	*HP 0-163-H*	*HP 970-CH*	*HP 970-FH*
General information											
Filter intended for	Fine precipitates	Medium precipitates	Coarse and gelatinous precipitates	Bacteria	Bacteria ultra filter	Bacteria ultra filter	Last traces of turbidity	Fine crystals	Fine crystals	Fine to moderately fine crystals	Moderately fine crystals
Weight of paper, g. sq. m.	85	85	85	50	38	67	79	68	95	135	280
Thickness of paper, mils	6	7	8	5.5	6.0	10	10.5	10	14.5	16.5	45
Specific gravity, g./ml.	0.565	0.486	0.422	0.36	0.25	0.27	0.3	0.275	0.26	0.325	0.25
Retention											
Meets Federal retention test	100% $BaSO_4$ hot	100% $PbSO_4$ cold	100% $Fe(OH)_3$ cold	100% $BaSO_4$ hot	100% $BaSO_4$ hot	100% $BaSO_4$ hot	100% $BaSO_4$ hot	100% $BaSO_4$ hot	100% $BaSO_4$ hot	100% $BaSO_4$ hot	100% $BaSO_4$ hot
Cone retention, % CaC_2O_4 cold	92	58	12	100	100	100	100	100	100	100	100
Retention under suction—CaC_2O_4 cold, %:											
Vacuum, in. Hg / No. of layers											
1 / 1	19	6.4	3.9	100	100	100	100	99.8	100	59	49
1 / 2	...	...	...	...	100	100	100	100	100	90.4	83
1 / 3	94.8	19.9	9.6	...	100	100	100	100	100	100	96.8
10 / 1	16.6	5.1	3.5	100	100	100	100	69.8	78.8	29.5	24.4
10 / 2	...	...	...	...	100	100	100	99.8	100	51.9	...
10 / 3	43	10.3	5.9	...	100	100	100	100	100	61.5	...
27 / 1	11.5	4.5	3.3	100	100	100	100	56.4	59.2	17.9	17
27 / 2	...	...	...	...	100	100	100	99.4	92.2	33.4	...
27 / 3	25	9.2	7.1	...	100	100	100	100	100	47.4	52
Retention under strong suction ~30 in. Hg and washing with 100 ml. H_2O (cold CaC_2O_4) %	4.5	~2.5	~1	100	100	100	~96	20.5	28.8	4.0	6.4
Retention under suction. CaC_2O_4 hot, %											
Vacuum in Hg. / No. of layers											
25 / 1	82	29	...	100	100	100	100	100	100	100	90.5
25 / 2	96.2	41	20.5	...	100	100	100	100	100	100	100
Rapidity or filter speed, sec.											
Cone rapidity, sec.	160–210	46	10	None	47	39	39	19	24	13	4
ΔS rapidity in sec. under suction, 1000 ml. dist. H_2O											
Pump indicator: 27 in. Hg	95	12	2.5	85	53	12	23	12	13	~2.0	~2.0
Pump indicator: 10 in Hg	268	28	5	220	125	32	55	37	35	4.5	4.5
Pump indicator: 1 in. Hg	~1100	116	20	1000	368	127	198	93	131	15	16
Rapidity under water pressure: 1000 ml. tap water, sec.											
Filter pressure ~30 in. Hg	820	200	20	1400	600	170	187	60	95	27	22

Filter pressure ~4 in. Hg	>10,000	1200	210	>20,000	>7000	1800	2400	700	1100	240	160	
Air resistance, mm. H_2O at air velocity 28 f.p.m. (85 l./m. passes 100 cm.)	...	240	70	...	253	185	240	117	170	56	45	
Burst wet-strength, 10 sq. cm. area rupture in. H_2O	10–11	11–12	9–10	>30	11	17	17	14	7	14	20–25	

Grades: HP 970-FH, HP 970-CH, HP 934-AH, HP 602, HP 597, HP 604—in production, Hurlbut Paper Co., South Lee, Mass.
Grades: HPO-859-H, HPO-512, HPO-849-2H, HPO-153-H—pilot plant developments, Hurlbut Paper Co., South Lee, Mass.
Membrane filter: Lovell Chemical Co., Watertown, Mass.

(A) necessary to filter 250 to 1000 ml. of clean, prefiltered, tap water under 30 in. water pressure through an area of 10 sq. cm. was measured (Hertzberg instrument). The time necessary to pass 1000 ml. of water without filter (B) is subtracted from A. The recorded filter speed in Table II: $C = A - B$.

Cellulosic filter 602 shows a rapidity of 820 sec., while the inorganic filter, 970-FH, with a somewhat similar retention, shows a filter speed of only 22 sec. The best inorganic ultra filter O-512 shows a filter speed of 170 sec.

Rapidity for 4-in. Water Pressure. The test is performed in the same way as the 30-in. filter pressure test. The filter speed should rise proportionally with the filter pressure. Under normal testing conditions, side effects will interfere and absolute functions are not obtainable in most cases. The determination of filter speed of filter paper is a much more complex affair than probably generally realized and is very much dependent upon the method employed. Every filter "slows down" as time, thickness, fiber material, and filtrate medium function. This is true for distilled water and more so if precipitates or clean tap water are employed to determine the filter speed. The faster the filter, the less effect is observable. Cellulosic filters with very high retentivity give, therefore, the most marked differences. While it may take 44 sec. to filter 250 ml. of water (cellulose filter 597) the time to filter 1000 ml. under the same conditions may be not 176 sec. (44 × 4), but 216 sec.

The air resistance, millimeters water, doubles or triples if the filter layer is doubled or tripled. The filter speed for liquids may follow other rules if the filter layers are doubled or tripled. One layer (934-AH glass) may need 13 sec. to filter 250 ml. water under 30 in. water pressure, with three layers 51 sec.; with one layer of cellulose paper 597, 44 sec., with three layers 216 sec. instead of 132 sec. (44 × 3) may be needed.

Strength Properties of Analytical Filter Papers

One hundred per cent inorganic fiber paper cannot and does not approach the strength properties of dry cellulosic filter papers but the wet strength, which is the main concern for the chemist, does compare very favorably as can be seen in the last column of Table II. Silica paper is the weakest member of our analytical filter developments, but some of the listed grades surpass the cellulosic paper in wet-bursting strength. The Hertzberg wet-burst method was employed as follows: 10 sq. cm. of the filter paper is exposed to increasing water pressure until the paper bursts. The water pressure in inches water at the moment of bursting is recorded.

All the test results are very much dependent upon the method employed. No absolute results are obtainable. The survey does point out, though, the general trend of what can be expected in a comparison. Any filter will vary, depending on the manufacturing procedure, with the weight, the density, the interfiber distance, the average fiber diameter, etc. Such filters may vary somewhat within the same lot or depending on variations with the fibers from one manufacturing lot to the next. The results indicate that the results are reproducible within reason for practical applications.

Chemical Stability of Cellulose Filters vs. Inorganic Filters

The ideal would be a filter paper which cannot be attacked by any of the solutions which the average chemist has to use in his laboratory. The wish would be, therefore, a submicron filter which cannot be attacked by acids or alkali or solvents of any kind. Teflon fibers, for instance, would approach such an ideal state.

While cellulose, which cannot be considered as an inert material even toward water, is not an ideal fiber material for analytical filter paper, inorganic fiber papers with which we deal in this report are still far away from an ideal product also, and it is not expected in the near future that such a material will be developed. Very pure quartz fibers or very pure aluminum silicate fibers give, of course, the best results in regard to chemical stability, and such fibers show properties which approach, in many respects, practical requirements for most analytical applications.

Table III shows the chemical resistance of two inorganic fiber materials suggested for analytical filter paper grades (used for 934-AH, 970-FH, and 970-CH.)

Scribner and Wilson (*6*) reported the solubility of cellulose filter papers in water, 0.2 N H_2SO_4 and 0.2 N NaOH. These results should be compared with the chemical resistance of the available inorganic fibers, especially the ceramic fibers which appear to be favorable in some respects in this comparison.

Ma and Benedetti (*4*) reported practical tests with E-glass fiber paper, grade 934-AH (see Table II) and conclude that the chemical stability of this product should be sufficient for most chemical analysis purposes. The weight losses were found to be insignificant in their chemical analysis.

Work is being done to develop glass fiber papers

Table III. Chemical Resistance of Two Different Inorganic Fibers

(Fibers suggested for analytical filter paper base)

	Ceramic fibers	*Glass fibers with medium-low chemical resistance*
Loss in weight after 24 hr. boiling in water, %	0.08	0.57
Loss in weight, leaching for 1 hr. in *N*-HCl at 96°C., %	6.14	20.62
Loss in weight, leaching for 1 hr. in H_2SO_4 (31.5° Bé) 96° C., %	5.4	17.5–30
Loss in weight *N* KOH at 20° C. for 24 hr., %	0.4	..
Loss in weight, 5 *N* KOH for 1 hr. at 90°C., %	16–25	55–72
Loss in weight, leached 1 hr. in *N* HCl at 20°C., %	0.34	..
Loss in weight, leached 1 hr. in conc. HCl, at 20°C., %	0.28	..
Loss in weight 5 *N* KOH, for 24 hr. at 20°C., %	2.0	2.5

with higher chemical resistance. Especially the newer ceramic fibers shown, as Table III reveals, an increased chemical resistance and they may, for this reason, be a good supplement for glass fiber paper.

Cellulose paper, which contains some ash, and inorganic fiber papers react somewhat with acids or possess some ion absorbency.

Table IV shows how the pH of the sulphuric acid solution of original pH 4.65 changes if two filter disks of 5.5-mm. diameter are placed in the solution and boiled for 5 min. Observe that the paper grade 934-AH takes up all the acid ions, while 970-CH takes up the acid ions but in a lesser degree (see chemical composition of glass and aluminum silicate in Table I).

ANALYSES WITH INORGANIC FILTERS

The basic difference between inorganic analytical filter papers and cellulose filter papers is that cellulose can be burned off completely through the action of high heat, while inorganic filter paper has practically no weight loss if exposed to an average heat of 1000 to 1400°F. for glass fiber paper, or 1000 to 2500°F. for grades 970-FH and 970-CH.

It has been outlined previously that some of the inorganic filter papers are ultra filters. It is possible to consider the following changes in some analytical work.

1. Filtering under strong suction to speed up the analysis.
2. Precipitation in the cold.
3. Reduction of or no standing time before filtering the precipitates.

This would mean that the new filters may yield a time-saving factor. The chemist could make more tests in the same time for certain test series

It may be advantageous also to use inorganic filters for solutions which would readily attack cellulose.

Table IV. Change of pH of 50 ml. H_2SO_4 Solution of pH 4.65 After Boiling for 5 Min. with Two Inorganic Fiber Paper Disks of 55-Mm. Diameter

H. P. Co. grade no.	*Weight of two filter disks, g.*	*pH of H_2SO_4 solution of pH 4.65 after boiling for 5 min.*
970-CH	0.43	5.65
934-AH	0.254	7.4
Blank	0	4.67

Cellulose filter paper is readily destroyed by strong acids, while aluminum silicate or glass fiber papers possess relatively good resistance against acid solutions.

Both cellulose and inorganic fibers are attacked in certain solvents or acids or alkali in a higher or lesser degree. Each of these materials will have some advantages for different working methods or different materials. It is not considered to replace cellulose filters but it is desirable to supplement the established, well-known cellulose paper grades with new, inorganic products which will give distinct improvements and advantages for special uses. Without trying to stress the beneficial points of inorganic fiber filter papers and assuming that the disadvantages are obvious from this report, there are two more points which can be solved more readily with inorganic fiber paper.

The heat necessary to burn cellulosic filters may be harmful to some substances on the filter. With inorganic fiber paper filters, the heat treatment can take place anywhere between 100 to 2200°F. for the proper inorganic filter.

Reoxidation after the burning of the filter may be unnecessary if inorganic fiber filters are employed. The burning of cellulosic filters has to be done carefully and it takes time to destroy the carbon in burning the filter. With glass fiber paper such would not be the case.

Cellulosic filters absorb moisture from the air and the water absorption varies with relative humidity anywhere between 4 to 14% weight gain, due to absorption of moisture from the air. Glass fibers absorb moisture on the surface of the fibers in an amount of 0.2 to 0.4% only.

The chemist may, at the start, have to go through more elaborate procedures with glass fiber paper to obtain the most exact results. He may have to make blank tests with the glass fiber filter paper used. This will have to be done, though, only at the initial start of test series if the test procedure can be standardized.

While the materials presented in this outline are all made of 100% inorganic material, each of these products could be manufactured bonded with a variety of binders. Up to 80 binder materials suitable for this purpose have been evaluated.

Bonding of glass fiber paper with small amounts of suitable binders, in general, does not influence the retention at all. Filter speed may be reduced up to 10 or 20% or more, depending upon the binder material employed. The dry and wet strength of such bonded inorganic fiber paper is appreciably increased, of course, and similar paper grades show an increase in strength up to 10 times, both for wet and dry strength.

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Received Feb. 9, 1955.

The assistance of his co-workers in preparing the samples reported herein is gratefully acknowledged by the author.

Tappi

TECHNICAL SECTION

Vol. 38, 1955

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Published by the
Technical Association of the Pulp and Paper Industry
155 East 44th Street, New York, N. Y.

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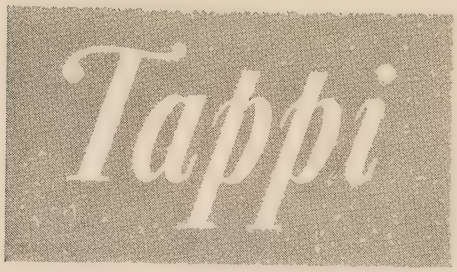

GENERAL SECTION

Vol. 38, 1955

Editor
R. G. MACDONALD

Assistant Editor
R. T. Bingham

Published by the
Technical Association of the Pulp and Paper Industry
155 East 44th Street, New York, N. Y.

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ASSOCIATION NEWS AND EVENTS

Local Section Meetings

Pacific: Jan. 10, 1956, Everett, Wash., Engineering Program; March 2, 1956, Camas, Wash., Shibley Award Program; May 17–19, 1956, Gearhart, Ore., Annual Meeting, Joint Meeting with Pacific Div., APPMS Association.

New England: April 6, 1956, Roger Smith Hotel, Holyoke, Mass.; June 8–9, 1956, Oceanside Hotel, Magnolia, Mass.

Southeastern: Jan. 20–21, 1956, Francis Marion Hotel, Charleston, S. C.; March 23–24, 1956, Roosevelt Hotel, Jacksonville, Fla.; May 18–19, 1956, King & Prince Hotel, Brunswick, Ga.

Lake Erie: Jan. 20, 1956, Hotel Carter, Cleveland, Ohio, "Printing Equipment," visit to Harris Press; March 23, 1956, Steubenville, Ohio, "Production and Process Control," visit to local paper mills; May 18, 1956, Cleveland, Ohio, Annual Meeting.

Empire State: June 7–9, 1956, Whiteface Inn, Lake Placid, N. Y., Annual Meeting.

Empire State Central District: All meetings held at University Club, Syracuse, N. Y.; Jan. 6, 1956, "Methods of Coloring Paper," by Maurice Landberge, General Dyestuff Corp., New York, N. Y.; Feb. 3, 1956, "Paper Machinery Developments"; March 2, 1956, "Converting Paper with Plastics"; April 6, 1956, "Papermaking in Europe," by Robert F. Vokes, Dilts Machine Works, Fulton, N. Y.

Empire State Western District: Feb. 1, 1956; April 4, 1956; and May 2, 1956.

Empire State Northern District: Jan. 12, 1956, Students Night, "Beater Additives," by S. Earll Church, College of Forestry, State University of New York, Syracuse, N. Y.; Feb. 9, 1956, "Machinery Developments," by representatives of Sandy Hill Iron & Brass Works, Hudson Falls, N. Y.; March 8, 1956, "Titanium Pigments in Paper," by H. C. Brill, E. I. du Pont de Nemours & Co., Inc., Newport, Del.; April 12, 1956, Empire State Award Night; and May 10, 1956, Annual Meeting.

Empire State Eastern District: Queensbury Hotel, Glens Falls, N. Y.; Jan. 20, 1956; Feb. 17, 1956; March 16, 1956; April 20, 1956; and May 18, 1956.

Empire State Metropolitan District: Fraunces Tavern, Pearl and Broad Sts., New York, N. Y., Jan. 10, 1956; March 13, 1956; April 10, 1956; and May 8, 1956.

Chicago: Chicago Bar Association Rooms, 29 S. LaSalle St., Chicago, Ill., Jan. 9, 1956, "New Methods of Printing on Corrugated"; Feb. 13, 1956, "Folding Cartons"; March 12, 1956, "Laminating and Waxing"; April 6, 1956, "Surface Treatment of Paper and Board"; and May 16, 1956, Annual Meeting.

Lake States: Jan. 10, 1956, Northland Hotel, Green Bay, Wis., "Sulphite Spent Liquor Utilization"; March 13, 1956, Hotel Conway, Appleton, Wis., C. J. West Award Program; April 10, 1956, Beloit, Wis., visit to Beloit Iron Works, Engineering Program; and May 8, 1956, Annual Meeting.

Ohio: Meeting at American Legion Hall, Middletown, Ohio, Jan. 12, 1956, "New Machinery Developments in the Paper Industry," visits to plants of Black-Clawson Co.; Feb. 14, 1956, "Stock Preparation," by James d'A. Clark, Consultant, Longview, Wash.; March 8, 1956, "Fiber Swelling," by I. H. Isenberg, Institute of Paper Chemistry, Appleton, Wis.; April 10, 1956, Awards Program; and May 10, 1956, Hartwell Club House, Cincinnati, Ohio, Annual Meeting.

Delaware Valley: Engineers Club, Philadelphia, Pa., Jan. 26, 1956, "Management," by Frank Federia; March 29, 1956, "Cylinder Machines" (Panel); April 26, 1956, "Corrosion Inhibition," by J. R. Coursault, W. H. & L. D. Betz Co., Philadelphia, Pa.; and May 31, 1956, "E. J. Albert Award Program."

Maine-New Hampshire: June 28–29, 1956, Poland Spring House, Poland Spring, Me., Annual Meeting.

Kalamazoo Valley: Hotel Harris, Kalamazoo, Mich., Jan. 12, 1956; March 1, 1956, "Testing"; April 5, 1956, "Filler Retention"; May 17, 1956, Western Michigan College Night, Annual Meeting; July 24, 1956, joint outing with Michigan Division APPMS Association, Gull Lake Country Club.

Committee Appointments

Paul Bartholomew of the Minnesota & Ontario Paper Co. has been appointed vice-chairman of the TAPPI Testing Division.

Many members of the Technical Association have inquired from time to time how they may serve on the committees of the Association. Any member who may wish to become a committeeman should write to the Secretary of the Association, 155 E. 44th St., New York 17, N. Y. Participation in committee work should be premised on a willingness to devote some personal time to committee projects; attend committee meetings and conference; have the support of company managements.

The work of the committees is extremely important to the progress of Association work. Committees organize conferences, prepare monographs, establish standards, prepare data sheets, conduct surveys, prepare special reports, and administer research projects. There is much important work to be done.

TAPPI 41st Annual Meeting

The 41st Annual Meeting of the Technical Association of the Pulp and Paper Industry will be held at the Commodore Hotel, New York, N. Y., on Feb. 20–23, 1956.

Members of the Association should remember to bring their 1956 membership cards with them since the lower registration fee will be limited to individuals who can present their 1956 cards. All individuals attending the Annual Meeting must register.

MONDAY, FEBRUARY 20, 1956

9:30 a.m. First General Session (East Ball Room)

K. O. Elderkin, President of TAPPI, Bowaters Southern Paper Corp., Calhoun, Tenn., *Chairman*

1. Secretary's Report, by R. G. Macdonald.
2. President's Address, by K. O. Elderkin.
3. Report of the Teller's Committee.
4. Report of the Joint Textbook Committee, by R. S. Kellogg, *Secretary.*
5. "Water Availability for Industrial Development," by C. G. Paulsen, Division of Water Resources, U. S. Geological Survey, Washington, D. C.

10:00 a.m. Wax Testing Committee (Room A)

2:00 p.m. Wet Strength and Interfiber Bonding (East Ball Room)

K. W. Britt, Scott Paper Co., Chester, Pa., *Chairman*

1. "Non-Woven Fabrics," by J. J. Osmar, Chicopee Corp., Milltown, N. J.
2. "Atomistic Approach to the Crosslinking of Cellulose and Its Reaction with Fillers," by P. Lagally, Linden Laboratories, University Park, Pa.
3. "Beater Adhesives and Fiber Bonding—the Need for Further Research," by J. W. Swanson, Institute of Paper Chemistry, Appleton, Wis.
4. "The Use of Synthetic Fibers in Paper," by J. R. Emery, J. D. Howell, and S. Sands, E. I. du Pont de Nemours & Co., Wilmington, Del.

2:00 p.m. Committee Meetings (Grand Ball Room)

Tables assigned to committees will be indicated by table cards.

Research and Development Division (Grand Ball Room)

J. J. Thomas, S. D. Warren Co., Cumberland Mills, Me., *General Chairman*

Statistics Committee—John F. Langmaid, Jr., S. D. Warren Co., Cumberland Mills, Me., *Chairman*

Microbiological Committee—B. F. Shema, W. H. & L. D. Betz Co., Philadelphia, Pa., *Chairman*

Industrial Division (Grand Ball Room)

R. L. Davis, Detroit Sulphite Pulp & Paper Co., Detroit, Mich., *General Chairman*

Nonfibrous Raw Materials Committee—E. N. Poor, Hudson Pulp & Paper Co., Augusta, Me., *Chairman*

Water Committee—A. Thurn, Champion Paper & Fiber Co., Hamilton, Ohio, *Chairman*

Agricultural Fibers Committee—E. R. Carpenter, The Weston Paper & Mfg. Co., Terre Haute, Ind., *Chairman*

Structural Fibrous Materials Subcommittees—R. G. Lacey, Celotex Corp., Marrero, La., *Chairman*

Converting and Consuming Division (East Ball Room)

F. D. Long, Container Corp. of America, Chicago, Ill., *General Chairman*

Graphic Arts—C. A. Morton, West Virginia Pulp & Paper Co., Chicago, Ill., *Chairman*

Coating Committee—R. T. Trelfa, Watervliet Paper Co., Watervliet, Mich., *Chairman*

Wet Strength Committee—K. W. Britt, Scott Paper Co., Chester, Pa., *Chairman*

Plastics Committee—J. C. Pullman, American Cyanamid Co., New York, N. Y., *Chairman*

Corrugated Containers Committee—H. T. Scordas, Union Bag & Paper Corp., Savannah, Ga., *Chairman*

Pulp Manufacture Division (Grand Ball Room)

E. O. Ericsson, Puget Sound Pulp & Timber Co., Bellingham, Wash., *General Chairman*

Alkaline Pulping Committee—M. B. Pineo, Brunswick Pulp & Paper Co., Brunswick, Ga., *Chairman*

Mechanical Pulping Committee—F. W. O'Neil, College of Forestry, State University of New York, Syracuse, N. Y., *Chairman* (Tuesday 2:00 p.m. Room E)

Chemical Products Committee—Arthur Pollak, Consulting Engineer, New York, N. Y., *Chairman*

Pulp Purification Committee—W. H. Rapson, University of Toronto, Toronto, Ont., *Chairman*

Acid Pulping Committee—N. S. Lea, Scott Paper Co., Everett, Wash., *Chairman*

Semichemical Pulping Committee—J. N. McGovern, Parsons & Whittemore, New York, N. Y., *Chairman*

Dissolving Pulp Committee—F. A. Simmonds, Forest Products Laboratory, Madison, Wis., *Chairman*

Paper Deinking Committee—J. L. Clouse, Oxford Miami Paper Co., W. Carrollton, Ohio, *Chairman*

Paper Manufacture Division (Grand Ball Room)

H. C. Moore, Beloit Iron Works, Beloit, Wis., *General Chairman*

Preparation of Papermaking Materials Committee—F. S. Klein, Byron Weston Co., Dalton, Mass., *Chairman*

Cylinder Board Committee—Glen T. Renegar, Container Corp. of America, Manayunk, Pa., *Chairman*

Fourdrinier Committee—N. R. Phillips, Riegel-Carolina Corp., Acme, N. C., *Chairman*

Testing Division (West Ball Room)

J. P. Casey, A. E. Staley Mfg. Co., Decatur, Ill., *General Chairman*

Nonfibrous Materials Testing Committee—K. H. Williams Mid States Gummed Paper Co., Chicago, Ill., *Chairman*

Pulp Testing Committee—F. E. Caskey, Morden Machine Co., Portland, Ore., *Chairman*

Optical Properties Committee—D. N. Obenshain, West Virginia Pulp & Paper Co., Luke, Md., *Chairman*

Microscopy Committee—I. H. Isenberg, The Institute of Paper Chemistry, Appleton, Wis., *Chairman*

Paper Testing Committee—L. Price, U. S. Government Printing Office, Washington, D. C., *Chairman*

Chemical Methods—A. S. O'Brien, Eastman Kodak Co., Rochester, N. Y., *Chairman*

Wax Testing—G. C. Rumberger, Marathon Corp., Menasha, Wis.

Engineering Division

J. D. Lyall, Armstrong Cork Co., Lancaster, Pa., *General Chairman*

Steam and Power Committee—W. Wyburn, Federal Paper Board Co., Bogota, N. J., *Chairman*

Chemical Engineering Committee—L. C. Jenness, University of Maine, Orono, Me., *Chairman*

Corrosion Committee—S. J. Baisch, Thilmany Pulp & Paper Co., Kaukauna, Wis., *Chairman*

Mill Maintenance and Materials Committee—L. L. Mrachek, The Mead Corp., Kingsport, Tenn., *Chairman*

Mill Planning and Economics Committee—R. A. Packard, Hopkinton, Mass., *Chairman*

Engineering Research and Machine Design Committee—R. G. Quinn, Johns-Manville Corp., Manville, N. J., *Chairman*

Electrical Engineering Committee—M. J. Osborne, Bowaters Southern Paper Corp., Greenville, S. C., *Chairman*

Data Sheets Committee—J. W. Hemphill, Johns-Manville Corp., New York, N. Y., *Chairman*

Drying and Ventilating Committee—C. A. Young, Riegel Paper Corp., Milford, N. J., *Chairman*

Industrial Engineering Committee—J. M. MacBrayne, Union Bag & Paper Corp., Savannah, Ga., *Chairman*

TUESDAY, FEBRUARY 21, 1956

9:00 a.m. Technical Manpower Availability and the Paper Industry (West Ball Room)

Harry F. Lewis, Institute of Paper Chemistry, Appleton, Wis., *Chairman*

9:00 a.m. Dissolving Pulp (South Room)

F. A. Simmonds, Forest Products Laboratory, Madison, Wis., *Chairman*

1. "Loblolly Pine High Alpha Prehydrolysis—Sulphate Pulps," by F. A. Simmonds, R. M. Kingsbury, J. S. Martin, and R. L. Mitchell, Forest Products Laboratory, Madison, Wis.
2. "Xylan and Mannan Removal During Prehydrolysis, Pulping, Purification, and Nitration," by R. L. Mitchell, M. A. Millett, W. E. Moore, and J. F. Saeman, Forest Products Laboratory, Madison, Wis.
3. "The Structure of Cellulose Fibers," by K. Lauer, University of Alabama, University, Ala.

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9:00 a.m. Structural Fibrous Materials (West Ball Room)

R. G. Lacey, Celotex Corp., Marrero, La., *Chairman*

1. "Racking Strength of Fiberboard Sheathing," by R. H. Neisel and J. F. Guerrera, Johns-Manville Research Center, Manville, N. J.
2. "The Insulation Board Institute and Its Relation to TAPPI," by W. J. Marshall, Insulation Board Institute, Chicago, Ill.
3. "An Evaluation of the TAPPI Standard SFMC Board Machine," by R. G. Lacey, Celotex Corp., Marrero, La.

9:00 a.m. Water (Room B-C)

A. Thurn, Champion Paper and Fibre Co., Hamilton, Ohio, *Chairman*

1. "Water Usage Practices in the Southern Kraft Industry," by Howard B. Brown, National Council for Stream Improvement, Baton Rouge, La.
2. "Multiple Use of Water—a Factor in Mill Location," by C. J. Velz, University of Michigan Ann Arbor, Mich.
3. "Modern Water Works Practices," by L. L. Klinger, Consolidated Water Power and Paper Co., Wisconsin Rapids, Wis.
4. "Modern Water Works Practices from the View of the Consultant," by A. L. Henderson, Consultant, New York, N. Y.
5. "Upflow Coagulation for Process Waters in the Pulp and Paper Industries," by J. S. Kneale, The Permutit Co., New York, N. Y.

9:00 a.m. General Session (Grand Ball Room)

1. "Modern Paper Cutting," by R. I. Haywood, Harris-Seybold Co., Dayton, Ohio.
2. "Efficient Metering of Papermakers Chemicals," by A. W. Lubbers, Milton Roy Co., Philadelphia, Pa.
3. "Vacuum Pump Design and Performance Characteristics: Centrifugal Exhauster versus Positive Displacement Cycloidal Type," by G. H. Crocker, Roots-Connersville Blower, Connersville, Ind.
4. "Corporate Inventions," by F. Makara, Patent Attorney, New York, N. Y.
5. "The Composition, Manufacture, and Use of Flexographic Inks," by F. A. Hamel, Jr., Bensing Bros. & Deeney, Philadelphia, Pa.
6. "Slurry Storage of Light Soda Ash," by J. H. McCracken, Diamond Alkali Co., Painesville, Ohio.

9:00 a.m. Wax Testing (Room A)

2:00 p.m. Cylinder Board (West Ball Room)

G. T. Renegar, Container Corp. of America, Manayunk, Pa., *Chairman*

1. An Examination of Odor Judging Methods in Paperboard," by A. Goldman, Airchem Inc., New York, N. Y.

2:00 p.m. Technical Manpower Availability and the Paper Industry (East Ball Room)

Harry F. Lewis, Institute of Paper Chemistry, Appleton, Wis., *Chairman*

2:00 p.m. Dissolving Pulp (South Room)

F. A. Simmonds, Forest Products Laboratory, Madison, Wis., *Chairman*

Symposium on the Evaluation of Dissolving Pulps

2:00 p.m. Water (Room B-C)

John G. Shotwell, Consultant, New York, N. Y., *Chairman*

Symposium on Boiler Feedwater Treatment

1. "Deionization of Boiler Feed Water," by Joseph Thompson, Illinois Water Treatment Co., Rockford, Ill.
2. "Recent Developments in Water Treatment for Boilers," by H. A. Grabowski, Falls Paper & Power Co., Oconto Falls, Wis., and H. D. Ongman, Combustion Engineering, Inc., New York, N. Y.
3. "Breakpoint Chlorination," by S. A. Cole and W. C. Taylor, Wallace & Tiernan, Inc., Belleville, N. J.
4. "Automation of Feed Water and Process Water Plants," by V. J. Calise, Graver Water Conditioning Co., New York, N. Y.
5. "All-Welded Feed Water Heater," by John Wert, Foster-Wheeler Corp., New York, N. Y.
6. Panel Discussion on "Use of Amines in Feed Water Treatment," Panel Members:
   B. Turner, International Paper Co., New York, N. Y.
   J. Warner, Robert Gair Co., New York, N. Y.
   W. D. Turner, Columbia University, New York, N. Y.
   J. Weidman, W. H. & L. D. Betz Co., Philadelphia, Pa.

2:00 p.m. Alkaline Pulping (Grand Ball Room)

V. Woodside, Olin Mathieson Chemical Corp., New Orleans, La., *Chairman*

1. "High Yield Pulps from Tropical Hardwoods of the Brazilian Amazon," by K. Lauer, University of Alabama, University, Ala.
2. "Automatic Shower Control in Vacuum Washing," by A. A. Mann, S. D. Warren Co., Cumberland Mills, Me.
3. "Digester Repair to Abate Corrosion," by E. W. Hopper, J. F. Pritchard Co., Philadelphia, Pa.
4. "The Drainage Properties of Wood Fibers I. The Effect of Blending Southern Pine Kraft Pulp at Varied Freenesses upon Ultimate Freeness and Physical Properties," by S. E. Ayer, University of Alabama, University, Ala.
5. "Improvements in Recovery Furnace Precipitator Practice," by H. O'Rourke and S. Rabkin, Research-Cottrell Inc., New York, N. Y.
6. "Prevention of Slag Formation On Recovery Boilers," by H. Thompson, National Aluminate Corp., Chicago, Ill.

2:00 p.m. Wax Testing (Room A)

WEDNESDAY, FEBRUARY 22, 1956

9:00 a.m. Corrugated Containers (Grand Ball Room)

I. Lichtenstein, Avco Mfg. Corp., New York, N. Y., *Chairman*

Symposium on the Role of Industrial Engineering in the Manufacture of Corrugated Board

1. "The Role of the Industrial Engineer in Corrugated Container Manufacturing," by J. M. MacBrayne, Union Bag & Paper Corp., Savannah, Ga.
2. "Corrugated Container Plant Layout," by L. Ashwood, Ft. Wayne Corrugated Paper Co., Ft. Wayne, Ind.
3. "The Role of the Industrial Engineering Consultant in the Corrugated Container Industry," by C. J. Minnich, Jr., Stevenson, Jordan, and Harrison, Inc., New York, N. Y.
4. "Trends in Palletization and Unitization," by R. E. Frase, Signode Steel Strapping Co., Chicago, Ill.
5. "Criteria for Mechanization," by S. Lehman, S. & S. Corrugated Paper Machinery Co., Brooklyn, N. Y.

9:00 a.m. Fourdrinier Session (East Ball Room)

N. R. Phillips, Riegel Carolina Corp., Acme, N. C., *Chairman*

Symposium: New Developments in Fourdrinier Machines

1. "Suction Role Noise Reduction," by E. J. Justus and C. B. Dahl, Beloit Iron Works, Beloit, Wis.
2. "The Vorvac Separator for the Removal of Dirt and Gases from Papermaking Stocks," by H. Freeman and J. Broadway, Consolidated Paper Corp., Three Rivers, Que.
3. "The Vorject Cleaner for Pulp and Paper Stocks," by H. Freeman and J. Broadway, Consolidated Paper Corp., Three Rivers, Que.

9:00 a.m. Statistics (South Room)

John F. Langmaid, S. D., Warren Co., Cumberland Mills, Me., *Chairman*

9:00 a.m. Chemical Engineering and Acid Pulping Session (West Ball Room)

N. S. Lea, Scott Paper Co., Everett, Wash., and L. C. Jenness, University of Maine, Orono, Me., *Co-Chairmen*

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1. "Combustion of Sulphur in High Mass Velocity System," by W. de Vos and J. J. Shipman, Kimberly-Clark Corp., Neenah, Wis.
2. "Acid Plant Design," by J. H. Hull, Crown-Zellerbach Corp., Seattle, Wash.
3. "SO_2-H_2O-Na_2O: Vapor Liquid Equilibrium Measurements and Correlations," by F. Kotzerke and J. L. McCarthy, University of Washington, Seattle, Wash.
4. "An Investigation of the Mechanism of the Dewatering of Compressible Beds," by R. A. Hisey, S. D. Warren Co., Cumberland Mills, Me.
5. "The Drying of Paper," by A. C. Dreshfield, Jr., and S. T. Han, Institute of Paper Chemistry, Appleton, Wis.
6. "Panel"—Brick Linings.

9:00 a.m. Plastics (Room B-C)

J. C. Pullman, American Cyanamid Co., New York, N. Y., *Chairman*

Symposium on Permeability

1. "The Permeation of Mixed Gases," by C. Rogers, J. A. Meyer, V. Stannett, and M. Szwarc, College of Forestry, Syracuse, N. Y.
2. "The Permeability of Plastic-Treated Paper," by R. Bhargava, J. A. Meyer, V. Stannett, and M. Szwarc, College of Forestry, Syracuse, N. Y.
3. "The Effect of Water Vapor on Gas Permeability and Vice Versa," by C. Rogers, J. A. Meyer, V. Stannett, and M. Szwarc, College of Forestry, Syracuse, N. Y.
4. "Water Vapor Permeability," by V. Tammela, C. Rogers, J. A. Meyer, V. Stannett, M. Szwarc, College of Forestry, Syracuse, N. Y.
5. "Factors Affecting the Permeability Constant," by C. Rogers, J. A. Meyer, V. Stannett, and M. Szwarc, College of Forestry, Syracuse, N. Y.
6. "Studies in the Curing of Resin-Treated Papers with Radiant Heat," by S. A. Dalheim, F. W. O'Neil, and V. T. Stannett, College of Forestry, Syracuse, N. Y.

2:00 p.m. Preparation of Papermaking Materials

F. S. Klein, Byron Weston Co., Dalton, Mass., *Chairman*

1. "The Jones Double D Disk Type Refiner," by D. E. Jones, and E. H. Cumpston, E. D. Jones & Sons Co., Pittsfield, Mass.
2. "The Design and Operating Characteristics of the Sutherland Multipurpose Refiner," The Sutherland Refiner Corp., Trenton, N. J.
3. "Horizontal Rotary Filter for Fibrous Products," by J. A. Kenney, Dorr-Oliver Inc., Stamford, Conn.
4. "Beater Addition of Acrylic Polymers: Relation of Polymer Properties to Paper Strength," by L. P. Kelley and P. J. McLaughlin, Rohm & Haas Co., Philadelphia, Pa.
5. "A New Concept in Paper Sizing," by J. H. Ernlund, Minnesota Mining and Mfg. Co., St. Paul, Minn.
6. "The Adsorption of Gear by Pulp," by J. L. Keen and J. W. Opie, General Mills, Inc., Minneapolis, Minn.
7. "The Properties of Penob, a Product Made from the Conversion of the Total Organic Solids in Sulphite Waste Liquor to Resin," by A. A. Morton, H. S. Hooper, and R. J. Snare, Penobscot Chemical Fibre Co., Great Works, Me.

2:00 p.m. Corrugated Containers (Grand Ball Room)

R. L. Jenk, Mead Corp., Chillicothe, Ohio, *Chairman*

Symposium on the Strength Characteristics of Corrugated Board

1. "Strength Evaluation of Corrugated Boxes by the Drop Test Method," by K. Q. Kellicutt, Forest Products Laboratory, Madison, Wis.
2. "Compression Strength of Corrugated Containers," by R. C. McKee, Institute of Paper Chemistry, Appleton, Wis.
3. "Blow Absorption by the Corrugated Container," by J. G. Turk, Glass Container Mfg. Institute, Butler, Pa.
4. "Standards for Corrugated Containers," by C. J. Zusi, Container Laboratories, Inc., Chicago, Ill.
5. "The Concora Medium Tester," by G. Maltenfort, Container Corp. of America, Chicago, Ill.
6. "Liner-to-Medium Adhesion Strength," by M. Yezek, General Foods Corp., Battle Creek, Mich.
7. "The National Safe Transit Program and Its Application to the Corrugated Container Industry," by J. C. Oliver, National Safe Transit Committee, Washington, D. C.

2:00 p.m. Fourdrinier (East Ball Room)

N. R. Phillips, Riegel Carolina Corp., Acme, N. C., *Chairman*

1. "Evaluating Beta Gage Basis Weight Control Systems," by W. E. Van Horne, Industrial Nucleonics, Inc., Columbus, Ohio.
2. "Beta Ray Measurements of Moisture in Running Felts," by R. V. Osborn, Finch, Pruyn & Co., Glens Falls, N. Y., and D. B. Wicker, F. C. Huyck & Sons, Rensselaer, N. Y.
3. "Fibrous Fillers in the Paper Mill," by W. V. Arnold, Jr., and P. Calott, Wausau Paper Mills Co., Brokaw, Wis.
4. "Moisture Regulation in Paper Manufacturing," by J. D. Lynch, J. O. Ross Engineering Corp., Boston, Mass.
5. "Surface Chemical Studies on Pitch, I. A New Approach to the Pitch Problem in Papermaking," by John W. Swanson, Institute of Paper Chemistry, Appleton, Wis.
6. "Studies on Pitch Troubles—The Mechanism of Resin Deposition on Surfaces," by E. Back, Forest Products Research Laboratory, Stockholm, Sweden.

2:00 p.m. Acid Pulping—Recovery (West Ball Room)

E. H. Kennedy, Combustion Engineering, Inc., New York, N. Y., and B. Brunes, Swedish Steam Users Association, Stockholm, Sweden, *Co-Chairman*

Symposium on Spent Sulphite Liquor Recovery

2:00 p.m. Testing (South Room)

A. R. Ewing, Bemis Bros. Bag. Co., Boston, Mass., *Chairman*

1. "The Viscosity of Cellulose in Cupriethylenediamine Solution," by B. L. Browning and L. O. Sell, Institute of Paper Chemistry, Appleton, Wis.
2. "A Standard for the Comparison of Instruments or Methods of Test," by T. W. Lashof, J. Mandel, and R. D. Stiehler, National Bureau of Standards, Washington, D. C.
3. "The Erasure of Typewritten Characters on Paper," by P. Codwise, Beaver Wood Fibre Co., Thorold, Ont.
4. "Report on Literature Search and Industry Questionnaire on Pulp and Paper Testing," by C. L. Maton, The John I. Thompson Co., Washington, D. C.
5. "Statistical Approaches to the Study of Test Precision," by C. A. Bicking, Office, Chief of Ordnance, Washington, D. C.

THURSDAY, FEBRUARY 23, 1956

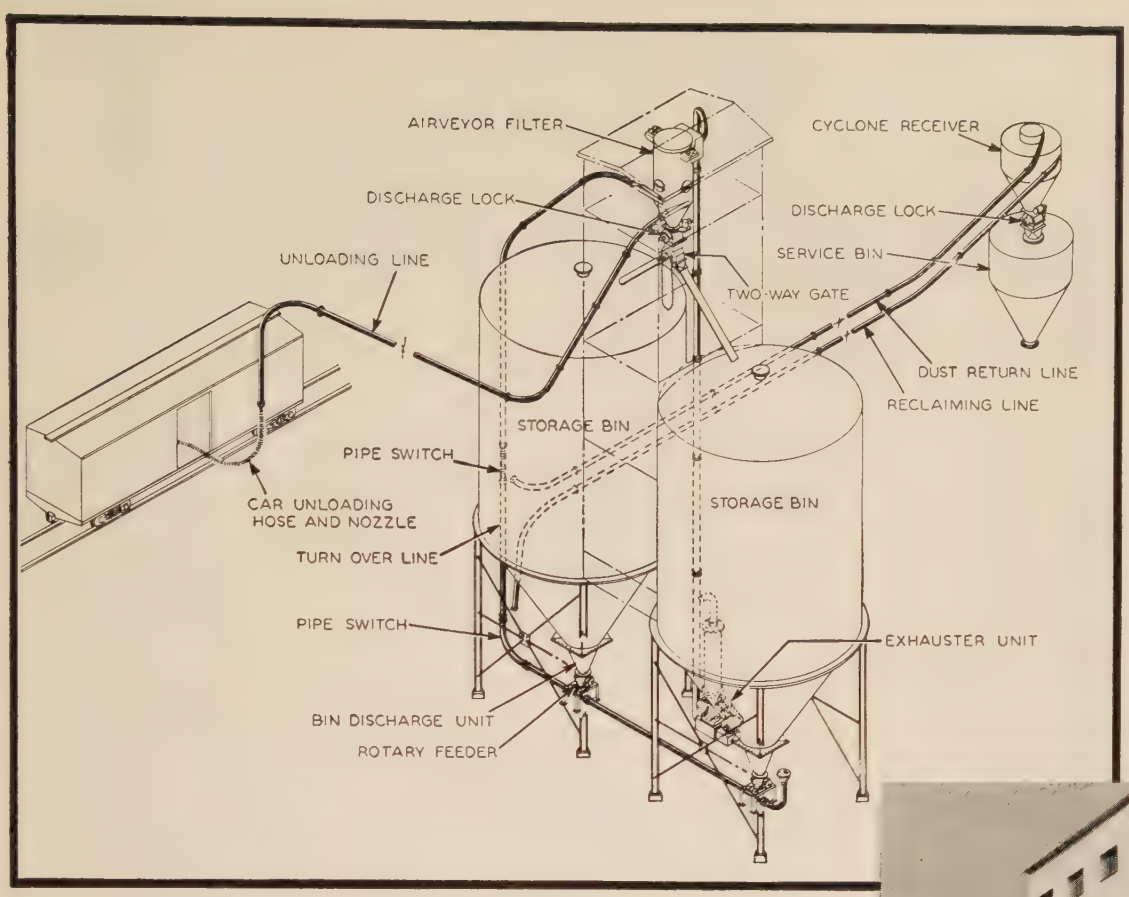
9:00 a.m. Corrugated Containers (Grand Ball Room)

F. D. Long, Container Corp. of America, Chicago, Ill., *Chairman*

Open Forum on Box-Shop Problems

Panel:

W. J. Goettsch, Samuel M. Langston Co., Camden, N. J.
E. L. Houz, Thrissell Engineering Co., Beverly, Mass.
R. L. Kreyling, Philadelphia Quartz Co., Philadelphia, Pa.
R. Sherman, A. E. Staley Co., Decatur, Ill.
A. Shields, S. & S. Corrugated Machinery Co., Brooklyn, N. Y.
F. E. Skiver, American Box Board Co., Grand Rapids, Mich.
W. F. Ward, F. X. Hooper Co., Glenarm, Md.
C. J. Zusi, Container Laboratories, Chicago, Ill.



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E. N. Olmstead, Eaton Dikeman Co.; G. M. Griffith, Jr., West Virginia Pulp & Paper Co.; L. L. Mrachek, The Mead Corp.; K. J. Mackenzie, Eastman Kodak Co.; M. J. Osborne, Bowaters Southern Paper Co.: J. W. Hemphill, Johns-Manville Sales Corp.; J. R. Curtis, Scott Paper Co.; and Stephen Chase, Jr., Champion Paper & Fibre Co.

9:00 a.m. Pulp Purification (West Ball Room)

W. H. Rapson, University of Toronto, Toronto, Ont., *Chairman*

1. "A Simplified Approach to Peroxide Bleaching," by E. Bishop, M. Doyle, M. May, D. MacLaurin, and C. Raaka, Shell Chemical Corp., New York, N. Y.
2. "The Mechanism of Formation of Chlorine Dioxide from Chlorates," by W. H. Rapson, University of Toronto, Toronto, Ont.
3. "Caustic Extraction of Refined Cellulose Pulp," by M. Wayman and D. L. Sherk, Columbia Cellulose Co., Prince Rupert, B. C., Canada.

9:00 a.m. Microbiological (South Room)

B. F. Shema, W. H. & L. D. Betz Co., Philadelphia, Pa., *Chairman*

1. "Microbiological Problems of the Pulp and Paper Industries," by W. M. Van Horn, Institute of Paper Chemistry, Appleton, Wis.
2. "A Birdseye View of Fungicides for the Paper Industry," by C. C. Yeager, Scientific Oil Compounding Co., Chicago, Ill., and R. T. Smith, Mosinee Paper Mills, Mosinee, Wis.
3. "The Mechanisms Involved in Microbiological Action; General Conditions," by G. A. Cruickshank, National Aluminate Corp., Chicago, Ill.

9:00 a.m. Semichemical Pulping (Room B-C)

J. N. McGovern, Parsons and Whittemore, New York, N. Y., *Chairman*

1. "High-Yield Neutral Sulphite Pulps," by G. Ceragioli, E. L. Keller, and G. H. Chidester, Forest Products Laboratory, Madison, Wis.
2. "Mechanical Pulping—A New Process," by C. W. Converse, Sprout, Waldron & Co., Muncy, Pa.

12:45 p.m. Annual Luncheon

K. O. Elderkin, *Presiding*

Tenth Engineering Conference

The Tenth Engineering Conference of the Technical Association of the Pulp and Paper Industry was held at the Rice Hotel, Houston, Tex., Nov. 7–9, 1955. A total of 603 delegates attended the meeting, which was sponsored by the TAPPI Engineering Division, J. D. Lyall, Armstrong Cork Co., Lancaster, Pa., *Chairman.*

The committee in charge of arranging the conference was as follows: Karl R. Bendetsen, Champion Paper & Fibre Co., Pasadena, Tex., R. M. Buckley, East Texas Pulp & Paper Co., Evadale, Tex., and W. L. McHale, Southland Paper Mills Inc., Lufkin, Tex., *Advisory;* Stephen Chase, Jr., Champion Paper & Fibre Co., David C. Edmiston, Sr., Southland Paper Mills, John Hartman, East Texas Pulp & Paper Co., J. K. Pound, Champion Paper & Fibre Co., and R. W. Kent, Champion Paper & Fibre Co., *Local Arrangements;* R. A. Hart, Champion Paper & Fibre Co., *Publicity;* G. A. Jackson, Champion Paper & Fibre Co., *Registration;* J. L. Henderson, Champion Paper & Fibre Co., *Mill Tours;* T. W. Edwards, Jr., Champion Paper & Fibre Co., *Hotel Arrangements;* H. M. Burnette, Champion Paper & Fibre Co., *Hospitality.*

Features of the conference included 12 technical sessions, 10 discussion sessions, a dinner, an Engineering Division Luncheon, and visits to pulp and paper mills near Houston. In addition, all of the 13 committees of the Division held meetings during the conference.

The following account includes brief reports of the papers presented during the technical sessions. The full texts of the papers will be published in future issues of *Tappi.*

Technical Sessions

Monday, November 7, 1955

The conference was opened on Monday morning, November 7, by John D. Lyall, Armstrong Cork Co., Lancaster, Pa., general chairman of the TAPPI Engineering Division. Mr. Lyall welcomed the delegates to the conference and presented the other officers of the division: W. C. Bloomquist, General Electric Co., Philadelphia, Pa., *Retiring Secretary,* H. O. Teeple, International Nickel Co., New York, N. Y., *Secretary-Elect,* and J. R. Curtis, Scott Paper Co., Chester, Pa., *Vice-Chairman.* Stephen Chase, Jr., Champion Paper & Fibre Co., *Local Arrangements Chairman,* was also presented by Mr. Lyall, who then turned the meeting over to K. J. Mackenzie, Eastman Kodak Co., Rochester, N. Y., chairman of the first technical session, on Hydraulics.

Hydraulics Session

"The Flow Properties of Paper Pulp Stock—III. The Relation of Shear Value to Pipe Friction for Pipes of Various Diameters," by Richard E. Durst and Lyle C. Jenness, University of Maine, Orono, Me. A correlation was found and previously reported, which related the laboratory measured shear value of four "type" pulps to the pipe friction of those pulp slurries flowing through a piping system comprised of nominal 6-in. spiral welded steel pipe.

Hydraulics Committee

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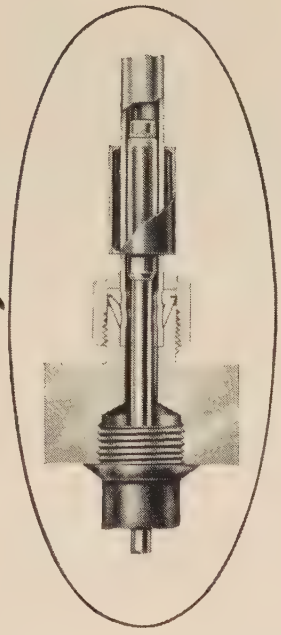

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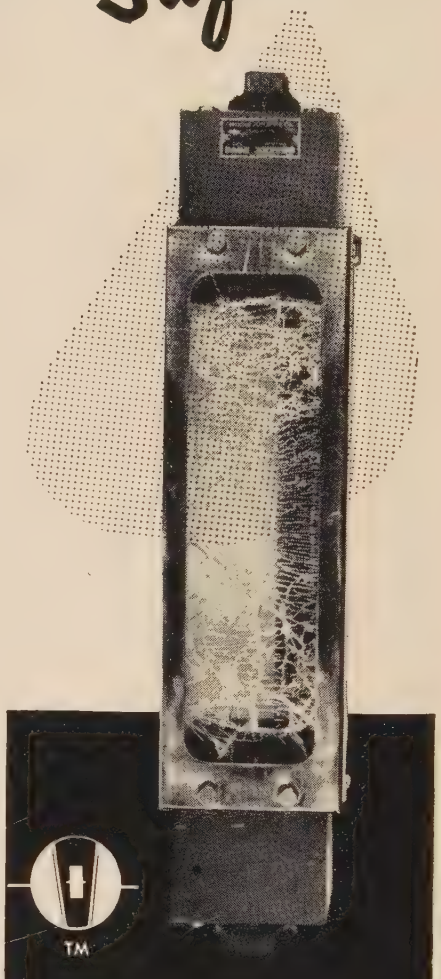

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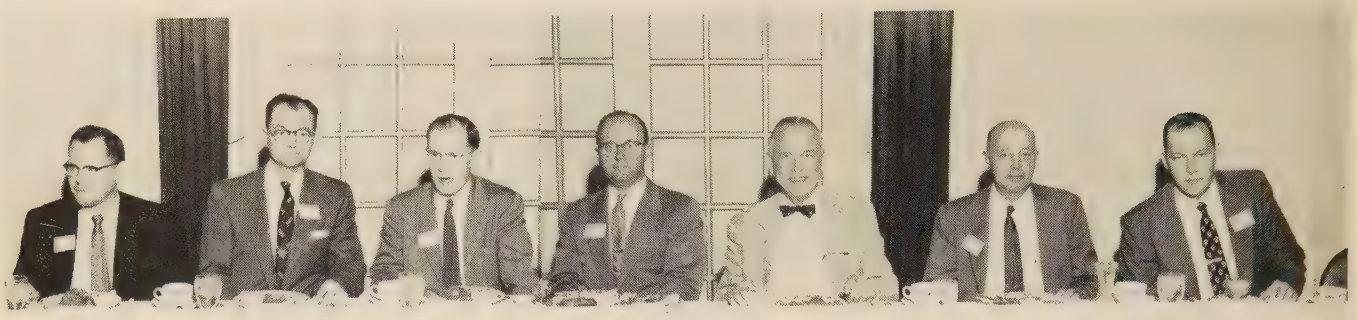


S. J. Baisch, Thilmany Pulp & Paper Co.; C. A. Young, Riegel Paper Corp.; R. G. Quinn, Johns-Manville Corp.; J. M. MacBrayne, Union Bag & Paper Corp.; R. A. Packard, consultant; W. M. Wyburn, Federal Paper Board Co., Inc.; and M. F. Gade, Kimberly-Clark Corp.

The flow system was modified to include test sections of the same pipe in 8 and 12-in. diameters. Friction head loss curves was determined for bleached sulphite and bleached soda pulp slurries in the new test sections.

A new empirical correlation based on data from the above pipe diameters is proposed which makes possible the calculation of pipe friction in flow systems of various pipe diameters, for any stock on which the shear stress velocity rheogram has been determined. The accuracy of the calculated pipe friction appears to be of a much higher order than that given by any previously proposed method of calcuation for a variety of stocks and for a number of pipe diameters.

Sanitary Engineering Session

The second session, on Sanitary Engineering, was held under the chairmanship of George M. Griffith, West Virginia Pulp & Paper Co., Luke, Md., chairman of the recently-formed TAPPI Sanitary Engineering Committee. Mr. Griffith presented the first paper of the session, titled "The Sanitary Engineering Committee—Its Scope and Objectives."

The Sanitary Engineering Committee of the Engineering Division of TAPPI has been established to provide mill engineers with engineering information in the fields of water supply, water treatment, and stream sanitation.

Following Mr. Griffith's presentation, Howard Brown, National Council for Stream Improvement, presented a discussion of "Industry Is Progress in Effluent Engineering," prepared by Harry W. Gehm of the National Council. Mr. Brown presented slides showing pulp and paper mill effluent purification systems in use in all parts of the United States.

K. O. Elderkin, Bowaters Southern Paper Corp., Calhoun, Tenn., president of TAPPI, addressed the delegates briefly on behalf of national TAPPI, commenting on the present acute shortage of engineers in the pulp and paper industry. Mr. Elderkin stressed the role of engineers now employed in the industry in rectifying the situation. Every opportunity must be taken to acquaint high school and engineering school students with the opportunities that exist for them in the pulp and paper field.

General Session

A General Session was also held on Monday morning, under John D. Lyall, Armstrong Cork Co., Lancaster, Pa., Chairman. This session consisted of the presentation by M. J. Osborne, Bowaters Southern Paper Corp., Calhoun, Tenn., of a paper titled "Underwater Storage of Pulpwood—Engineering Features," by M. J. Osborne, R. Q. Conner, Crossett Paper Mills, Crossett, Ark.; Willie St.-Laurent, Consultant, Montreal, Que.; F. G. Wilson, J. E. Sirrine Co., Greenville, S. C.; John W. Morgan, Celli-Flynn, McKeesport, Tex.; and K. Chesley, Crossett Paper Mills, Crossett, Ark.

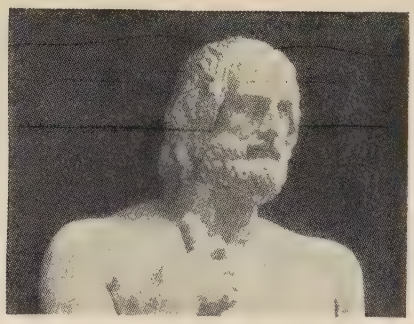
Southern pulpwood storage problems are unique in many respects. Southern pine decays very rapidly during the summer months when piled on the ground. Since the period of safe storage is limited, a mill cannot build an adequate stock pile. It is little known but well established that decay stops when wood is immersed in water. Southern pine is unlike Northern woods in that it becomes water-logged and sinks. Storage under water would provide an additional feature as water-soaked wood has a practically constant moisture content.

K. O. Elderkin while at Crossett Paper Mills in Arkansas became convinced that the place to store southern pine was under water and decided to do something about it. A model 30,000 cord log storage pond was designed in order to develop proper wood storage and retrieving machinery, and to study the behavior of watersoaked pulpwood in water.

Based on the Crossett studies, it was early decided that Bowaters should have a means of storing pulpwood under water at their Tennessee mills. Some of the unique engineering features of the underwater wood storage and wood handling machinery at Bowaters Southern Paper Corp. were discussed. This wood handling system is especially unique since two species of wood are handled separately into and out of underwater storage. Wood used in this mill is brought in by barge, truck, and rail. It was necessary to have unloading equipment which could receive this wood from these three sources and deliver to a central point for barking. The pond is divided into two semicircular basins, one side for grinder wood storage and the other side for kraft wood storage. Each side has a storage capacity of 16,000 cords. Pulp logs are reclaimed from the pond by two rotating electric gantry cranes as required for use in the mill.

The new Crossett Paper Mill underwater pulpwood storage system was described. The conveyor to the log pond and the return to the wood room is a water flume system. The pond is similar to the model with sloping concrete-lined sides and a graveled bottom. It is approximately 452 ft. in

Sanitary Engineering Committee



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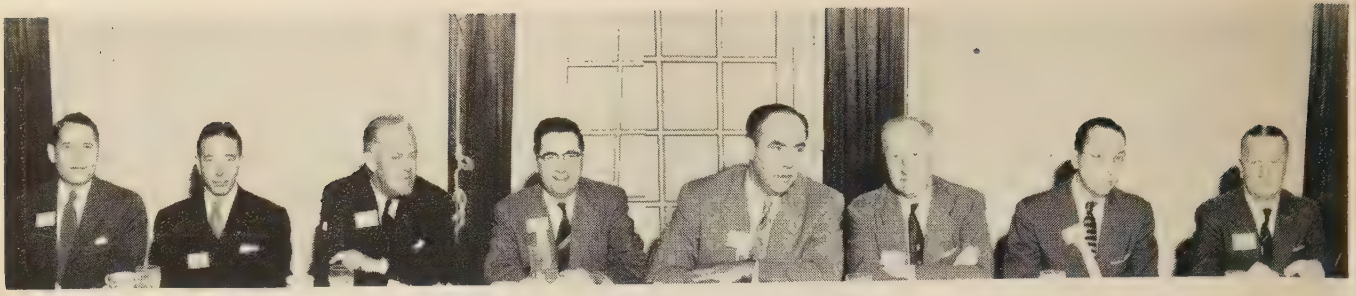

W. D. Harrison, Riegel Paper Corp.; K. R. Bendetsen, Champion Paper & Fibre Co.; A. D. Bruce, University of Houston; J. D. Lyall, Armstrong Cork Co.; W. C. Bloomquist, General Electric Co.; R. G. Macdonald, TAPPI; H. O. Teeple, International Nickel Co.; and L. C. Jenness, University of Maine

diameter with a maximum water depth of 40 ft. It has a capacity of 25,000 cords of barked pulpwood and 15 million gallons of water.

The log reclaiming system consists of a single electric gantry crane privoted at the center, a conical discharge apron and a turntable.

Mill Maintenance and Materials Session

On Monday afternoon a Mill Maintenance and Materials Session was held under L. L. Mrachek, The Mead Corp., Chillicothe, Ohio, chairman of the TAPPI Mill Maintenance and Materials Committee. Brief reports of the two papers presented during this session are given below.

"New Installations—Maintenance vs. Contract Work," by E. L. Cowan, Bowaters Southern Paper Corp., Calhoun, Tenn. We are faced with the problem of deciding whether to use maintenance forces to put in new installations or to let work to outside contractors. The important considerations are completion time, cost, and scope, labor relations, the type of job, and the area in which the work is to be done. Top management pays close attention to new work and insists that it be completed as soon as possible. Performing new work with maintenance labor would allow the project to be converted to an operating unit sooner than if a contractor were doing it. On large projects with early completing dates, the contractor is well adapted to handle the work. However, there is a tendency on the part of the contractor to drag out the work. Assuming that a maintenance crew is large enough to handle a job the direct cost of using a mill crew is less than the cost of using outside contractors. On the other hand, using mill crews for new work sometimes leads to neglect of preventive maintenance and results in costly major breakdowns. Inconsistencies in the plans or engineering would be exposed more readily and the cost of correcting them kept to a minimum if mill crews were used. There exists a danger that mill men become accustomed to doing new construction and when it is decided to let work to an outside force strained relations are created. Mill crews soon become overstaffed when they begin to perform more and more new work. The effect of the transfers and layoffs when the new work is completed leads to uncomfortable employee-management relations. Separate facilities have to be provided for the contractor's men to prevent work stoppages at the mill from jurisdictional disputes and strikes of the contractor's men. Contract men ignore plant regulations regarding safety and smoking, making it difficult to enforce the regulations among mill men. The wage scale difference between the contract men and the mill men is a sensitive morale problem. It is desirable to contract the work of the specialty trades. The contractor is liable to disrupt the mill production by his interference in operating areas. A thorough analysis of the advantages and disadvantages of using either work force should be made before a decision is reached.

"Methods of Cleaning Rubber Covered Suction Rolls," by R. H. Smith, Beloit Iron Works, Beloit, Wis. Basically, there are three possible approaches to the problem of keeping the suction rolls clean. First, cleaning is done according to a definite schedule as dictated by the mill's preventive maintenance program. Second, regularly scheduled inspections are made with rolls being cleaned as determined by inspection reports. The third method might be termed "delayed action scheduling," that is, the rolls are cleaned at the last possible moment and usually after there has been a noticeable decrease in suction roll efficiency. Obviously, the first or second method is the logical answer to this problem.

To clean the suction rolls, any one of a number of different methods can be used; the best for any particular mill has to be determined by their operating conditions. Nevertheless, the various methods can be divided into the following categories, namely, (1) use of chemical solutions, (2) use of hydraulic pressure, (3) combination of both pressure and chemicals, and (4) mechanical methods.

A discussion session on "Training Programs and Methods of Training Mill Personnel" was moderated by E. J. Bartlett, Union Bag & Paper Corp., Savannah, Ga., with the following panel: Dallas E. Henry, Southern Advance Bag & Paper Co., Hodge, La.; Leonard Menius, East Texas Pulp & Paper Co., Silsbee, Tex.; and C. Wayne Smith, Crossett Paper Mills, Crossett, Ark.

Mr. Bartlett stated that more thought, time, and energy is devoted to the selection, placement, and training of maintenance personnel than is true with the average job in industry today. The reason for this attention is obvious once we recognize that the trained mechanic has behind him four years of job training in his particular trade and hundreds of hours of classroom time in a variety of subject fields.

Because the training of maintenance personnel costs a company a great deal of money, the selection of personnel is very important. The selection must include physical requirements, mental make-up, educational background, initiative, aptitude, personality, and attitude.

Mill Maintenance and Materials Committee

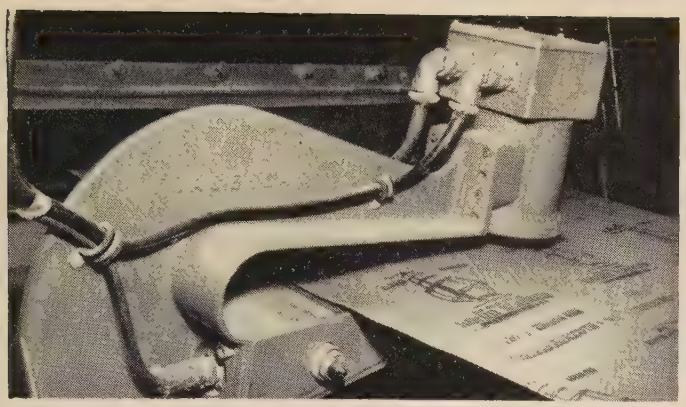

Fig. 1 — Beta Gauge measures paper stock and printing to give initial base measurement, detect variations. Stock weights for various products run from 4 to 65 lbs./330 sq. ft.

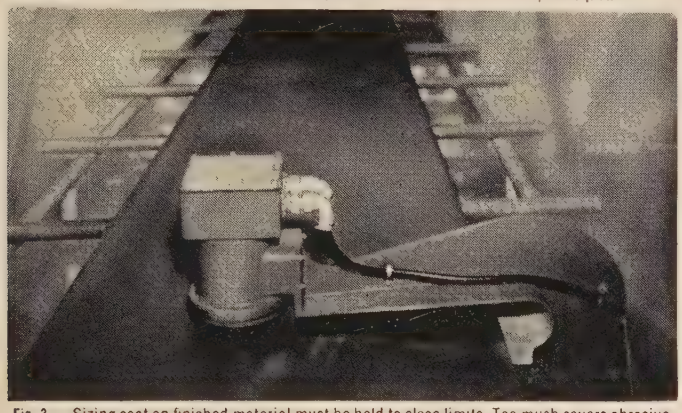

Fig. 3 — Sizing coat on finished material must be held to close limits. Too much covers abrasive, inhibiting cutting action. Too little fails to lock grains in place. Gauge helps attain ideal coating weight for most efficient cutting action.

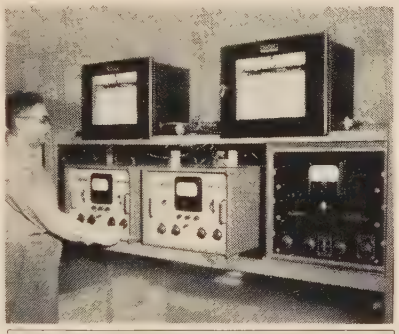

Fig. 4 — Machine tender sets "zero" against which Beta Gauge #1 will register plus or minus variations from the norm. Consoles for gauges #2 and #3 are to the right in same shelf. Two-pen instrument (upper left) indicates and records measurements of gauge #1 and #2 and shows net deposit of adhesive. In same manner, instrument on upper right shows net deposit of abrasive grain.

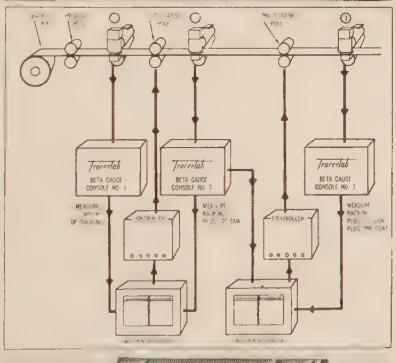

Fig. 5 — **IS THIS YOUR APPLICATION?** Schematic flow diagram of Beta Gauges, recorders and automatic control console for a coated product application (not Sandpaper) shows a set-up of Tracerlab Beta Gauges to indicate base stock variations and automatically control deposition of separate coatings. Arrangements can be made for measuring and controlling any number of coatings.

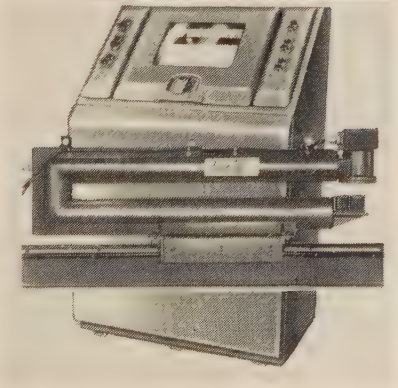

Fig. 6 — Latest model of Tracerlab Beta Gauge and Automatic Standardizing Console are designed for maximum adaptability for those locations where even occasional operator attention is impractical. Fifteen second standardization at preset intervals, in plant use since 1949, corrects for all environmental changes such as plant atmospheric conditions and changes in circuit components. Request information brochure.

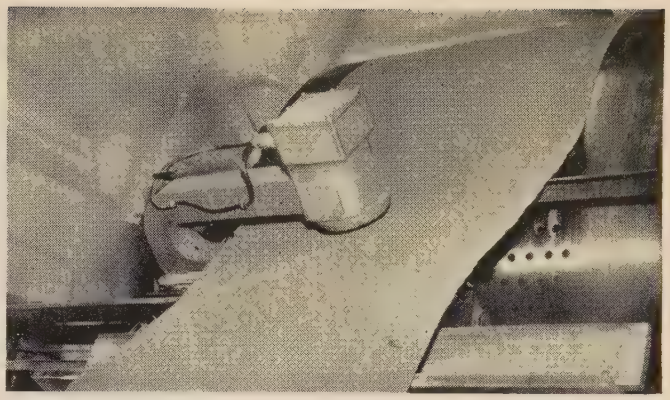

Fig. 2 — Amount of abrasive deposited per unit area is a critical element in quality. Here, Beta Gauge measures stock, printing, adhesive and abrasive. Instrumentation indicates and records results in terms of abrasive weight.

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After Tracerlab Beta Gauge monitoring was installed in 1953 it was no longer necessary to stop for sampling. Now the gauges are set for the product, the line started and machine adjustments made during the production run. Production was increased 14%, spoiled merchandise reduced to a fraction of its former figure, significant additional time-and-labor savings realized, and a permanent chart record obtained of each run.

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Gauge 1, (fig. 1) measures the paper backing stock and printing as a basis for subsequent measurements of materials deposited on it.

Gauge 2 is located just behind the rolls which apply the base adhesive and measures the stock plus printing plus adhesive. Instrumentation (fig. 4) is arranged to show both gauges 1 and 2 on a two-pen recorder which indicates the amount of adhesive deposited.

Gauge 3, (fig. 2) measures stock, printing, adhesive and abrasive deposition. Instrumentation (fig. 4) recording gauges 2 and 3 which indicates the abrasive coating.

Gauge 4 is located just following a drying festoon and its measurement is used to form a basis for measuring at gauge 5 the sizing applied.

Gauge 5, (fig. 3) measures base stock, printing, adhesive, abrasive and sizing. Instrumentation records gauges 4 and 5 which indicates sizing.

Close control of quality level, as obtained through this Tracerlab Beta Gauge installation, plus other modern production techniques are two important reasons why Clipper Abrasives are recognized throughout industry as one of the finest products of their kind obtainable.

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Chemical Engineering Committee

When considering the type of equipment and material that maintenance personnel work with, it is obvious that training plays a vital role in any maintenance program. Training is a continuous process. It does not stop when the apprentice or helper has been promoted to journeyman. Because of the complexity of the trade, and because of the many new processes, techniques, and materials that are being introduced it can readily be seen that continued training of mechanics is necessary to keep abreast with the technological progress that is being made today.

A company can make a substantial investment in what appears to be a good training program, but unfortunately, many programs fail to achieve the desired results because the over-all company climate is not such as to ensure success. By climate we mean the attitudes that prevail between the supervisory group and the trainees themselves. The supervisors as a group must have a genuine interest in people. They must also have a desire to help. The trainee, on the other hand, in addition to aptitude, knowledge, and skills, must be proud of his profession, have a great deal of drive and initiative and must understand and fully appreciate that there is dignity in labor.

If we had all of the essentials listed we still might not have an effective program if it is operated on a faulty or shaky foundation. The foundation of maintenance training is certainly based on the safety factor. All of the money and attention is rendered ineffective if the products of the program find their way into the safety director's report as a statistic.

Many training programs have been administered under the delusion that training should be job-centered rather than man-centered. This has resulted in more failures than many companies would like to admit. Training, to be effective, must take into consideration the man, not only the trainee but also his fellow workers and the management team as well.

Tuesday, November 8, 1955

Chemical Engineering Session

L. C. Jenness, University of Maine, Orono, Me., and chairman of the TAPPI Chemical Engineering Committee, was chairman of a Chemical Engineering Session held on Tuesday morning. Following are condensations of the two papers presented.

"Notes on Liquor Circulation in Digesters," by J. E. Wilkinson, Champion Paper & Fibre Co., Canton, N. C. A brief history was given of the operating and development experience which led to the present external liquor circulating and indirect heating system as it is applied to alkaline pulping digesters cooking both pine and hardwoods. Details of the present system used to produce bleachable pulp using a three-hour cooking cycle were presented.

Design data, including comparison of various materials of construction and discussion of liquor circulating and heat transfer rates, were presented. Design details of digester screen, circulating piping system, indirect liquor heater, and liquor circulating pump were given.

Details of operating and maintenance practice were discussed with emphasis being placed on the effects of liquor circulating rates and scale deposits within the system on the cooking cycle. The scale deposit removal method and general maintenance experience and practice were discussed.

The advantages and disadvantages of the system were discussed with reference to pulping uniformity, capital and maintenance costs, and savings resulting from recovery of cooking steam condensate.

"Thermal Compression Evaporation of Spent Pulp Mill Liquor: Application and Design of the Over-All Heat Balance," by R. V. Kleinschmidt and E. C. Bowen, The Bowen Corp., Cambridge, Mass. This paper discussed the possibilities of improving the over-all heat balance of pulp and paper mills by the use of thermal compression evaporators either alone or in conjunction with multiple effect evaporators of conventional form. There is opportunity for control of the relative use of heat (fuel) and power, depending on their relative cost, and substantial savings may be obtained by suitable application of the thermal composition process. After a brief résumé of the factors involved in the interconversion of heat and power, the heat balance of a mill is considered: first, the available power supplies—hydro, waste fuel by-product, and condensing, and the utilization of power, and of heat at various temperature levels. The thermal compression process of evaporation was described and its characteristics compared with those of the familiar steam power generating cycle and with a refrigeration machine. The third part of the paper discussed those characteristics of the mill which tend to favor the application of thermal compression to the concentration of waste liquors such as relative cost of power and fuel, amount of low pressure steam used, and of by-product power available, boiler steam pressure and temperature, etc. The fourth part discussed the features of the thermal compression evaporation process and equipment which tend to make for high efficiency and economy in its operation. A final section gave some comparative performance figures for four plants of the same capacity and general characteristics but using: (1) conventional six-effect evaporators heated with 50-lb. steam; (2) a plant originally half the capacity of (1), brought up to capacity by addition of thermal compression evaporators; (3) a new plant designed with high pressure boilers and thermal compression evaporators; and (4) a plant having ample low-cost hydro power, relatively expensive fuel with thermal compression evaporators. A number of charts were included from which the approximate effect of thermal compression evaporators on the heat balance of almost any of the common types of pulp and paper mills can be estimated.

Drying and Ventilating Session

Curt A. Young, Riegel Paper Corp., Milford, N. J., retiring chairman of the TAPPI Drying and Ventilating Committee, was chairman of a Drying and Ventilating Session, during which two papers were presented. Digests of the papers follow.

"Air Filtration as Applied to Paper Mill Ventilation," by James W. May, American Air Filter Co., Louisville, Ky. There is a considerable amount of moisture and heat liberated in many paper mill operations and means are usually provided to ventilate the areas involved. The removal of dust from the ventilation air is desirable both for product and equipment protection and air filters are usually installed in connection with the air handling units. Typical of these require-

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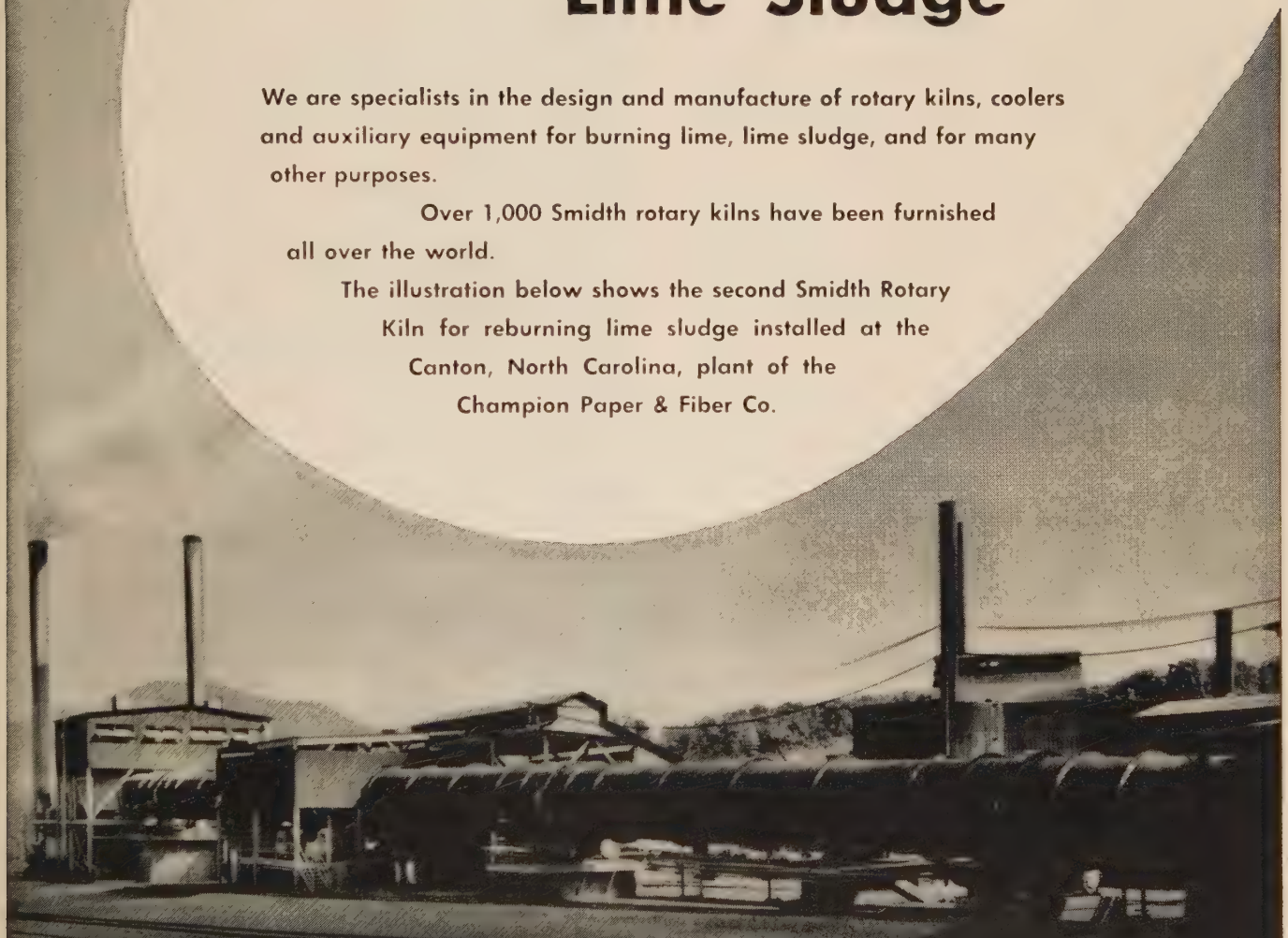
The illustration below shows the second Smidth Rotary Kiln for reburning lime sludge installed at the Canton, North Carolina, plant of the Champion Paper & Fiber Co.



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ments is the supplying of make-up air to machine rooms, converting departments, finishing rooms, etc. The filtering of the air supplied for the cooling and ventilation of electrical equipment is also important.

Since it appears that only moderate orders of cleaning efficiency are required for many paper mill applications, the viscous impingement filter has been widely used for this type of service. Viscous impingement filters range from the inexpensive disposable type of unit to the automatic self-cleaning filters which require attention at only infrequent intervals. Filters for paper mill service should be rugged and as maintenance-free as possible. Within the past two years there has been developed a new type of automatic filter which uses a pre-charged glass blanket type of media supplied in roll form. The filter actually operates on the viscous impingement principle but it has the characteristics of a dry type of filter in that no adhesive reservoir is necessary. Maintenance has been reduced to a minimum in the design of this new filter, as a single roll of clean media is expected to provide 12 months of service when handling normal concentrations of atmospheric dust. Around-the-clock operation and high dust concentrations will, of course, reduce the media life proportionally.

In selecting air filters for a paper mill, consideration should be given to the question of corrosion—especially for those applications associated with integrated plants. In some instances it may be necessary to use special materials or to require surface treatment of the exposed metal parts with some type of corrosion resistant coating.

"An Investigation of Condensate Behavior and Syphoning in Paper Machine Driers," by R. E. White, Villanova University, Villanova, Pa. The transfer of heat from steam to the shell of a paper drier is controlled by the hydrodynamics of the condensate in the drier. An experimental study of some of the factors involved reveals that the dynamics of the condensate and the performance of the siphon system are inter-related.

The physical form assumed by the condensate (ponding or rimming) depends upon the quantity of residual condensate, the drier speed, and the drier diameter. The residual condensate depends upon the efficacy of the siphon system which, in turn, depends chiefly upon the physical form of the condensate. Other factors effecting siphon performance are drum speed, pressure differential, and physical dimensions and location of the siphon.

The speed at which the condensate will begin to rim is a function of the diameter, D, and the residual condensate, L, and may be expressed as

$$V = f\,(1/D)\,L\,1/3$$

A rotating siphon functions dependably and effectively only when the condensate is rimming. The quantity of residual condensate is very sensitive to the proximity of the siphon tip to the drier wall but less so to the pressure differential except at low differentials and high speeds. If the pressure differential is well above the centrifugal force acting on the condensate in the siphon pipe and the condensate is rimming, the drier speed has a minimum effect upon the quantity of residual condensate.

Corrosion Engineering Session

The chairman of the Corrosion Engineering Session was S. J. Baisch, Thilmany Pulp & Paper Co., Kaukauna, Wis., chairman of the TAPPI Corrosion Committee. The following are condensations of the two papers comprising this session.

"Experiences with Digester Corrosion in a Mexican Pulp Mill," by A. Tirado A., Fabrica de Celulosa, Tlalpam, D. F., Mexico. A brief history was presented about failure and repairs made on two old corroded digesters. Digester wall thickness measurements and corrosion rates for those digesters

Corrosion Committee

were compared with values obtained from two new digesters. The information and methods of inspection described in TAPPI Monograph No. 12 proved to be very useful and have been applied with great advantage in recent years. Measurements of digester wall temperatures indicate they are high enough to explain corrosion by either hot plate boiling, acidity from chips, or both. Because of higher temperatures existing in the steel walls during the charging operation, it is believed that heavy steel walls, thick insulation, excessive corrosion allowance, increased cooking temperatures, short cooling periods between cooks, etc., all of these might contribute to explain higher corrosion rates of new digesters as compared with the rates found on digesters built several years ago. The use of Colmoney metal as an overlaying material and the installation of a distributing pipe which prevented liquor splashing, seemed to be useful in decreasing digester corrosion.

"Design Affecting Digester Corrosion in Alkaline Pulping—Committee Report," by L. G. Pfeiffer, A. O. Smith Corp., Milwaukee, Wis. Preferential corrosion attack on specific areas of digester walls is due to nonuniform circulation within the digester. In a natural circulation system, charging of the digester must be uniform for proper circulation.

Preferential corrosion takes place on the low side of an unevenly piled chip mass in a charged digester. Internal introduction of liquor has been a satisfactory solution, but presents new problems of an eroded area under the filling pipe and a loss in obtainable chip volume due to flotation. Placing the liquor inlet in the center of the chip inlet can be a satisfactory solution, but it requires a controlled filling technique. Use of a distributor ring for liquor fill is another satisfactory method.

Other requirements for proper circulation are uniformity of chip size, chip packers, liquor volume, proper steam emission, and adequate digester relief.

Corrosion problems with mechanical circulation systems can be lessened by welding a carbon steel plate between the strainer and shell. Use of multiple nozzles decreases the corrosion of the outlet nozzles.

Improper design of digester supports is responsible for accelerated corrosion in many digesters. Skirt-type supports eliminate the problems of a pedestal type, and they are used on 95% of present-day digesters.

Streak corrosion is caused by hot plate boiling due to the evaporation of cooking liquor on a hot metal surface. To prevent this, internal projections should be properly designed. Nozzles should have lip extensions or baffles to keep liquor away from the digester walls; thermowells should be directed downward; and unused nozzles should be blanked off flush with the digester wall.

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Annual meetings of both the American Paper & Pulp Association and Technical Association Pulp & Paper Industry held in February in New York City.

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Mill scale should be removed on carbon steel digesters before placing them into service. Because of the detrimental effects of sandblasting and grinding, and the expense of polishing, the standard mill finish is usually retained on alloy liner plates.

Stresses set up due to welding can cause stress corrosion cracking if not relieved. Some form of heat treating should be employed when practical to reduce these stresses. Peening may be used to stress relieve welds, but care must be taken to prevent work hardening. Radiographing permits a higher joint efficiency with accompanying reduced cost which offsets partially the increased costs of handling and radiographing.

Industrial Engineering Session

J. M. MacBrayne, Union Bag & Paper Corp., Savannah, Ga., was chairman of the Industrial Engineering Session, also held on Tuesday morning. Mr. MacBrayne acted as moderator of a panel discussion on the subject of "The Question of Power Selection for Plant Industrial Trucks." The panel members were: L. F. Carriker, Union Bag & Paper Corp., Savannah, Ga.; D. D. Hall, E. B. Eddy Co., Hull, Que.; W. A. McKenzie, Simpson Paper Co., Everett, Wash.; and L. J. Rowley, Lockheed Aircraft Corp., Burbank, Calif. Following are brief accounts of the remarks made by the panel members.

"Industrial Truck Cost Experience," by L. F. Carriker, Union Bag & Paper Corp., Savannah, Ga. Based on the experience of operating and maintaining 108 electric and 7 gasoline-powered trucks, it is felt that it is considerably cheaper to operate and maintain electric than it is gasoline-powered equipment. The results of 16 months' experience of a cost comparison study involving one gas and one electric 6000-lb. fork truck, two gasoline and two electric 10,000-lb. trucks

Industrial Engineering Committee

indicated a 2.6 to 1 maintenance cost of gasoline over battery equipment.

For the most part, electric equipment has the edge over gas in a number of areas. For example, battery power enjoys a cost ratio of 1 to 26 over gas. After figuring charging equipment and spare batteries, we still arrive at a final fuel cost of 12% less for battery power.

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being placed on operational costs, standardization of parts, and practical equipment design.

"Gasoline Fueled Factory Trucks," by W. A. McKenzie, Simpson Paper Co., Everett, Wash. The purchase of any factory trucks can be justified only because they reduce material handling costs. Economics of the over-all picture is the guide for selecting equipment, which should be made on the basis of the type and make that will earn the greatest return on the capital investment required for all the equipment involved, not just the vehicles. Such an analysis will point overwhelmingly in favor of gas engine powered trucks.

Some of the intangibles such as noise and exhaust gases in enclosed, high occupancy areas may at times overshadow economic factors and influence selection toward a less profitable investment.

Eighty per cent of all factory truck purchases are gasoline powered as compared to 25% 17 or 18 years ago.

Gasoline fueled trucks are lowest in initial cost for comparable capacities, and are the simplest to service; they will operate for longer periods without refueling; they will handle more tons per hour over equivalent distances and stacking heights.

Trucks powered by gasoline engines are faster, have more power, will operate over rougher terrain, up steeper grades, and in more inclement weather, than most other types.

Statements relative to advantageous economic picture for gasoline fueled trucks is likewise true of L.P.G. powered units where L.P.G. is readily obtainable at a sufficiently low cost, as are some of the operating characteristics. However, the use of L.P.G. is more hazardous around a manufacturing plant because it is handled at pressures from 65 to 135 lb. Insurance penalties may be assessed where L.P.G. is used.

Where gasoline engines are allowed to run idle for long periods, a switch to L.P.G. fuel will reduce engine repairs; however, that advantage decreases as the percentage of loaded engine time becomes larger until the usually higher cost of L.P.G. makes use of that fuel uneconomical.

"The Question of Power Selection for Plant Industrial Trucks—The Case for Diesel and Ready Power," by D. D. Hall, The E. B. Eddy Co., Inc., Hull, Que. The use of diesel and ready power units in our industry is not so great as that of gasoline or battery units. However, there are applications where both are favored. The industrial truck problems which each solves to good advantage are discussed.

"Lockheed Saves with LP-Gas," by L. J. Rowley, Lockheed Aircraft Corp., Burbank, Calif. Within the past four years liquid petroleum gas has been accepted as a fuel for industrial handling equipment.

After determining possible savings in operation and maintence, we investigated the practicality of converting our 130 units to propane. Management gave approval for a complete conversion of all units on the basis of our year-long investigation.

We installed a storage tank with a 10,704-gal. propane capacity and installed 10-gal. tanks on the units, sufficient for more than 8-hr. steady operation.

Following the panel discussion, Gilbert G. Murie, Ford Motor Co., Dearborn, Mich., presented a paper on "Automation at Ford," a digest of which follows. This paper brought out developments in the application of automation as we use it in the automotive industry. It covered the requirements for automation, such as alert management, proper machine tools, preventive maintenance, tool control, safety, and the reallocation of manpower. Each of these items was presented in general so that the listener would obtain an over-all knowledge of the factors involved. It pointed out those problems which face the manufacturer using automation and traced the development of an automation program. It summarized the advantages of more efficient use of machine tools, safety, increased production, quality,

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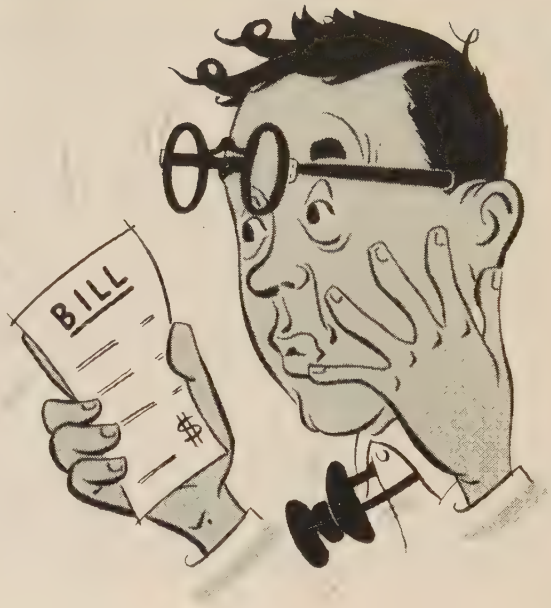

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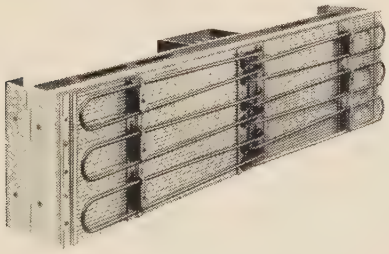

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Electrical Engineering Committee

and reduced manual labor for the machine operator and, also some of the disadvantages which have occurred.

A sound film was also presented, showing how Ford has applied automation in several different high production automobile parts.

Electrical Engineering Session

On Tuesday afternoon an Electrical Engineering Session was held under the chairmanship of M. J. Osborne, Bowaters Southern Paper Corp., Calhoun, Tenn., chairman of the TAPPI Electrical Engineering Committee.

"Preventive Maintenance for Paper Mill Rotating Machinery," was the title of the first paper presented by N. L. Danforth, St. Regis Paper Co., Bucksport, Me. Mr. Danforth reviewed the plant maintenance system in a two-machine mill producing 300 tons per day of white paper at speeds over 1200 f.p.m., 220 in. wide, including supercalendering operations. The paper included discussions of such subjects as antifriction bearing maintenance, lubricating problems, methods for shop maintenance and repair, inspection methods for new equipment before installation, methods and records used in tabulating space equipment, and safety problems related to electrical operating and maintenance crews in a plant of this type.

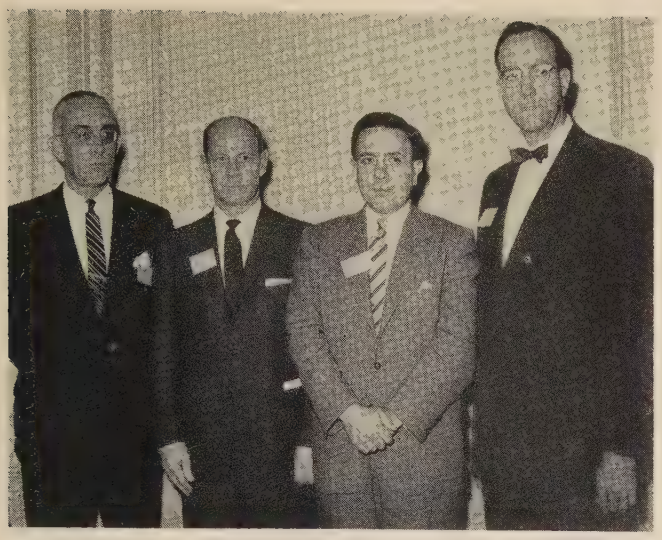
"Paper Mill Lighting Design and Economics," by H. C. Swannell, J. E. Sirrine Co., Greenville, S. C., was the title of the next paper, presented by title only. A brief condensation follows.

An industrial lighting system is related to the people who are concerned with plant operation. It is an investment in human relations and their reaction to better working conditions. With modern windowless type of buildings, good lighting is more important than ever before and its effect is reflected in plant operation, production, and employee morale.

Specifically, the purposes of an industrial lighting system are: (1) as an aid in all types of industrial operations; (2) to help provide safe working environment; (3) as an aid in conservation of sight and energy; and (4) as an aid in property protection.

The lighting system of a pulp and paper mill is virtually made up of a number of individual systems closely analogous to the structure of the mill buildings and functional areas of the yard. Each is independent of the other as to source of current and designed for each specific area. In many of the areas general illumination, augmented by special localized lighting is used, with full consideration of the visual requirement and safe working environment.

The lighting system as a whole is divided into sections, each



E. C. Bowen, Bowen Corp.; J. C. Harper, Downingtown Mfg. Co.; A. J. Cirrito, Rice Barton Corp.; and E. H. Olmstead, Eaton Dikeman Co., new committee secretaries

section being served from a unit substation or motor control center at either 480 or 575 volts. The source of current then is close to the center of the load and lengthy feeder circuits are avoided. This together with small capacity dry type transformers permits designs of the wiring system for operation within the allowable range of voltage variation.

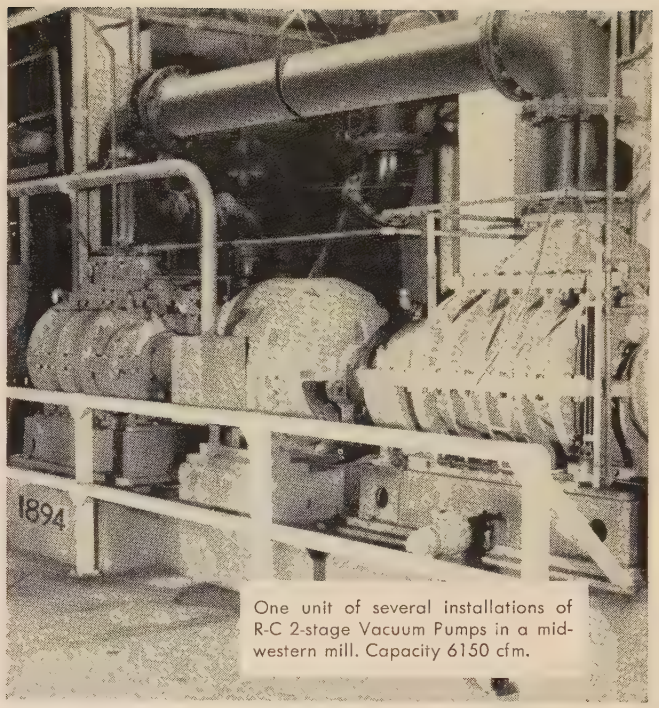
A lighting system represents an appreciable capital expenditure which can prove to be an expensive investment unless properly maintained. Systematic lamp renewal and cleaning programs will keep the system operating at maximum capability, otherwise the purpose of a lighting system is defeated. A well designed and well maintained lighting system makes better working conditions and consequent higher employee morale. This results in a smoother and better operating plant, a better product at top production, less spoilage and fewer seconds, better plant upkeep and appearance, fewer accidents and labor turnover.

A symposium on "Pulp and Paper Mill Power Distribution Systems" was led by S. A. Bobe, Westinghouse Electric Corp., Atlanta, Ga. Condensation of the papers presented are given below.

"Selection of System Voltage for Pulp and Paper Mills," by H. C. Swannell, J. E. Sirrine Co., Greenville, S. C. The primary voltage selected for the electrical distribution system of a new pulp and paper mill should be within the regulations of the National Electrical Code and permit system expansion. With proper safeguards, system voltages as high as 13,800 volts may be used.

For most paper mills the source of power is in the form of one or more turbine driven generators located near the load, and the utilization devices are the motors in the plant. It is the total capacity and characteristics of this equipment in relation to the capacity of available control equipment that form the basis of system voltage selection.

Each project should be given individual study, with the results weighed against possibility of system expansion. Based on the continued expansion of pulp and paper mills as experienced in the past, it is advisable even at the expense of economic considerations to select the system voltage that permits at least doubling the system capacity without resorting to external means of limiting possible fault currents. Based on a study of a series of assumed generator capacity with typical paper mill connected loads, the use of 2400 volts for system voltage should be limited to systems of less than 5000 kva. initial capacity. Similarly 4160 volts would be limited to systems of 5000 kva. and 7500 kva. initial



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J. D. Lyall receiving the cow bell from R. W. Kent of Champion

capacity. Systems in excess of 7500 kva. should be at 13,800 volts.

An intermediate system voltage of 6900 volts is available and its use would have many of the advantages of a higher voltage system. However, the over-all cost approximates that of a 13.8 kv. system and the control equipment does not offer the same marginal capacity for system expansion. Hence, there is no advantage utilizing this voltage level.

"The Expansion of Paper Distribution Systems in Paper Mills," by H. B. Greear, General Electric Co., Atlanta, Ga. This paper is wirtten around experience gained in the expansion of the electrical power distribution systems in approximately 50 southern paper mills, over a period of the past 30 years.

These expansions have been characterized by two very distinct trends, the first being to higher voltages, and the second to the use of unit substations for the distribution of power.

Also, in the past two years, the paper points out, a third trend has evolved, which is the utilization of larger individual turbine generators than have been used heretofore in paper mills.

The paper illustrates, by the use of single-line diagrams, the various steps in the expansion of the mill at the Union Bag & Paper Corporation, Savannah, Ga., over a period of 20 years, and also illustrates the expansion in the Bowaters Southern Paper Corp. mill at Calhoun, Tenn., as well as other representative mills in voltages from 480 to 13,800 volts.

Due to the electrical loads in most paper mills growing faster than their steam loads, this has made it economical for some mills to operate in parallel with the local power company, and the paper points out some very important considerations which should be taken into account in such cases.

As pointed out in the paper, the individual turbine-generator sizes have become so much larger than sizes installed a few years ago, that the development of conventional metal-clad switchgear in a rating of 750,000 kva. interrupting capacity at 13,800 volts has been necessary.

Due to the high power factor of the average paper mill load current limiting reactors can be used generously. This, in combination with available switchgear, now permits mills to expand to essentially any desired size at 13,800 volts.

The paper stresses the point of keeping the power distribution system simple, and in general radical, as complicated distribution systems in the past have not proved justifiable due to cost and increased difficulty in operating procedures.

The expansion of existing mills, as well as construction of recent mills, has also been characterized by the use of a grounded neutral at all voltage levels.

A. D. Bruce, President of the University of Houston addressing the Engineering Conference

Suitable grounding transformers are now readily available for all voltage levels for use in grounding the neutral of an existing delta connected power system.

The paper summarizes some conclusions that have proved very important to many mills in connection with their expansion programs.

"Typical Specification Guide Covering Apparatus for Electrical Distribution Systems for Pulp and Paper Mills," by W. M. Emmons, Westinghouse Electric Corp., Atlanta, Ga. Many factors dictate the selection of the generator and primary distribution voltage for pulp and paper mills. One of these is the cost, availability, and rating of power circuit breakers, in particular, the interrupting capacity and momentary ratings. This requirement should be exploited thoroughly before a decision is made.

A typical specification guide covers apparatus used in large pulp and paper mills who generate their electrical power. These are:

1. Indoor Metal-Clad Switchgear
   For generator and primary distribution. Usually with removable air-circuit breakers with associated instrument transformers, control power transformer, protective relay, metering, and control equipment. Outdoor metal-clad switchgear is used in some cases.
2. Control Switchboards
   For centralized control if desired. This is usually of the duplex type and includes instruments, meters, relays, voltage regulators, and control equipment required for the main metal-clad switchgear.
3. Outdoor Unit Substations
   Consisting of a three-phase transformer, usually oil insulated, throat connected to outdoor metal-clad switchgear with removable air circuit breakers of the same type employed for the indoor metal-clad switchgear.
4. Power Centers
   For 440-volt distribution consisting of a three-phase transformer, liquid filled or dry type, throat connected or close coupled to low-voltage metal-enclosed switchgear with drawout air circuit breakers. The rating of these is usually 750 kva. or 1000 kva.
5. High Voltage Motor Control Cubicles
   For control of 220 and 4000-volt motors consisting of totally enclosed steel cubicles with combination of high interrupting capacity magnetic contactors and current limiting fuses with associated control and protective devices. The magnetic contactors are air or oil and the starters are usually for full voltage starting.
6. Motor Control Centers
   For control of 440-volt motors consisting of totally enclosed steel cubicle assemblies with combination line starters consisting of magnetic contactors and thermal breakers

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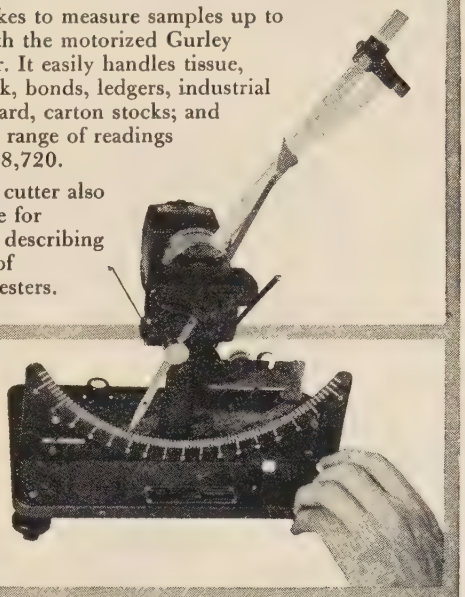

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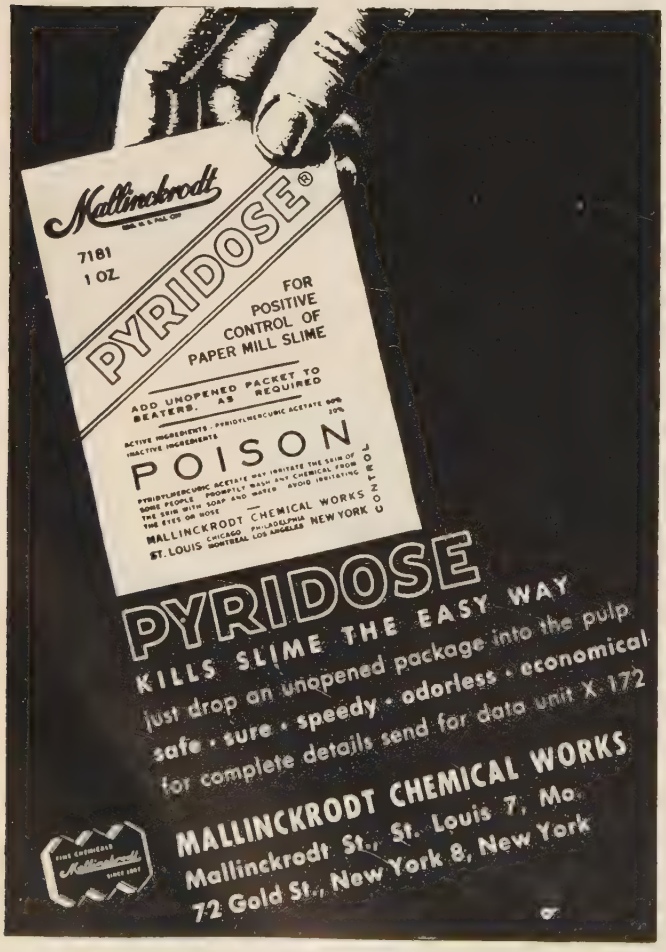
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Apparatus meeting the specifications described will provide the maximum safety, protection, flexibility, interchangeability and reliability required for a pulp and paper mill.

R. F. Sorenson, Union Bag & Paper Corp., Savannah, Ga., presented a data sheet consisting of a form for recording the down-time of electrical sectional drives on a monthly basis. This data sheet resulted from a study of electrical down-time on paper machine drives made by Mr. Sorenson under TAPPI project No. 435, sponsored by the Electrical Engineering Committee.

The final paper of the Electrical Engineering Session was titled "Commutation Problems of the Paper Mill," by D. E. Bivins, Jr., The Brown Paper Mill Co., Monroe, La. Sparking at the brushes of a d.c. motor or generator is only a symptom of poor commutation. When successful commutation is attained we will have long commutator and brush life, good machine performance, and freedom from excessive maintenance.

A copper oxide film on the surface of the commutator is essential to good commutation. Atmospheric contamination prevalent in paper mills, attacks the commutator film and constitutes the number one problem. When the film breaks down, we may have an increase in friction between the commutator and brushes. Selection of brushes best suited to form and maintain the proper commutator film in spite of the atmospheric contamination is the best available way to combat this problem.

Commutator wear, a product of commutation, results in our maintenance problem. If a mill has, for example 200 d.c. machines and their commutators wear at the rate of 12 mils per year average, in five years the commutators would have to be re-surfaced and undercut because of flush mica. This means that an average of 40 machines would have to have their commutators re-surfaced and undercut yearly.

Corrosion Engineering Session

The Corrosion Engineering Session was continued as a discussion session on Tuesday afternoon. C. Wayne Smith, Crossett Paper Mills, Crossett, Ark., gave the "First Report—Regional Digests Corrosion Investigation." Collecting digester corrosion data in a simplified form on a regional basis was started as a long term project of the Corrosion Committee to continue the study of digester corrosion. Data from 16 mills covering 125 digesters were examined. This initial data gives higher average corrosion rates than those found in past surveys. This points up need for more background data. This first evaluation was not conclusive because of lack of background information.

In 1950 the TAPPI Chemical Engineering Committee formed its Subcommittee on Digester Corrosion. This committee was given full committee status as the TAPPI Corrosion Committee in October, 1954. The stated purpose of this committee was to organize activities for the purpose of determining the cause and remedy for corrosion in sulphate and soda digesters.

The results of five years' committee activity were summarized by J. R. Lientz, S. J. Baisch, H. O. Teeple, and N. Shoumatoff in a paper titled "Five-Year Investigation of Digester Corrosion by the TAPPI Engineering Subcommittee."

The publication of the full length TAPPI Monograph No. 12 was a major contribution to the practical knowledge of digester corrosion problems. This monograph has been a valuable tool in the development of a system of control of corrosion in digesters by identification of critical conditions and the application of corrective and/or preventive maintenance where needed.

Following Mr. Smith's report, H. O. Teeple, International Nickel Co., New York, N. Y., presented a discussion of a

Steam and Power Committee

new questionnaire on corrosion problems and their economics, which is to be circulated by the Corrosion Committee.

Wednesday, November 9, 1955

Steam and Power Session

W. M. Wyburn, Federal Paper Board Co., Bogota, N. J., chairman of the TAPPI Steam and Power Committee, was chairman of a Steam and Power Session on Wednesday morning. Digests of the two papers presented are given below.

"Operations Planning for Industrial Steam Power Plants," by A. F. Richards, The Champion Paper and Fibre Co., Hamilton, Ohio. Steam and electrical power produced in the industrial steam power plant, although not the product that pays the dividends, is vitally essential to profit-making processes in industry. This energy must be furnished economically and in ample quantities when needed. An operating plan is needed to fulfill these requirements. This plan should cover normal operations and scheduled and forced shutdowns. In this way, forced production down-time can be kept to a minimum, thereby aiding in the profit making of the industry.

The plan is subject to the design of the power plant, and the nature of the industry served. Therefore, this paper describes the main features of a plan now in effect at the Ohio Division of the Champion Paper & Fibre Co. in Hamilton, Ohio. This industrial power plant is operated with a single boiler of 350,000 lb. per hour capacity at 600 p.s.i.g. and 750°F. Turbine equipment consists of a triple compound set of three units. All main line units are firmed by reliable spare equipment.

The plan evolves around two basic mediums, people and equipment, and, therefore, revolves into two projects (1) operator training and conditioning and (2) maintenance of equipment.

During a forced outage, the operating crew became a key factor. The well trained crew will best be able to restore service with a minimum of delay, and can also prevent minor incidents from developing into full-scale outages.

It is not advisable to rely solely on old school word-of-mouth training of operating crews. This method is uncontrolled both in frequency and substance. There are other more positive tools for training, including written instructions, emergency instructions, trial equipment runs, and many others of proven success not discussed in this paper.

The operating crew must have equipment in reliable running condition to turn out a successful operating performance. This makes the second part of the plan, a maintenance program, a definite necessity.

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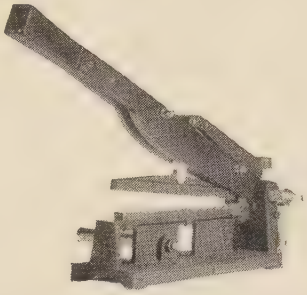

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The questions encountered in setting up such a program are numerous. The paper answers some of these questions by describing a plan that has been successful for a period of 25 years.

However, any good program develops weaknesses as time progresses, and constant vigilance is necessary to keep the good plan good. In the long run it's worth it. The paper-makers are kept busy, and the power engineer and his staff have the pleasure of sharing in a job well done.

"Burning Calcium-Base Spent Sulphite Liquor," by F. H. Coldwell, Nekoosa-Edwards Paper Co., Port Edwards, Wis. This paper was presented by R. V. Knapp, Mosinee Paper Mills, Mosinee, Wis., in the absence of Mr. Coldwell. The uncontrolled discharge of calcium-base spent sulphite liquor to natural streams results in some degree of pollution to the watercourse. Laws controlling the amount of allowable pollution have been enacted and sound conservation principles indicate a need for using this substance. One such use is as a fuel and its value for this purpose is potentially substantial. Burning provides an outlet without developing by-product markets and disposes of the substance in synchronism with the time of its production. Reasons are cited for greater advancement of this disposal method in Europe over that of the United States, and information on new developments in the method are included. The burning of spent sulphite liquor is only one part of the problem of successful utilization of the substance as a fuel. Because of this fact, the paper discusses, from the angle of the steam or power engineer who may be faced with the disposal of spent sulphite liquor by burning, the several major factors which must be considered in planning a successful burning installation. Methods of improvement in present mill practices which are related to these factors are given consideration. Problems in connection with concentration to a burnable consistency are enumerated and descriptions of systems to accomplish this purpose are included. Methods of burning the liquor in existing and special type furnaces are described with some indication of equipment limitations. Indications of results obtained in present-day installations are given and significance of liquor solids content and amount of collection on the economic balance of a proposed plant use shown.

Engineering Research and Machine Design Session

Two papers, digests of which are given below, were presented during a session on Engineering Research and Machine Design, under the chairmanship of R. G. Quinn, Johns-Manville Corp., Manville, N. J., chairman of the TAPPI Engineering Research and Machine Design Committee.

"Crystal Balls for System Designers—The Practical Story of Computers and Their Application in the Paper Industry," by R. C. Berger, General Electric Co., Cleveland, Ohio. Computers and analyzers provide system designers with a "crystal ball" whereby the performance of a mechanical or an electrical system can be predicted even before the final designs are completed. The C. C. Network Analyzer was developed nearly 40 years ago for the study of short circuit currents on electric utility systems. Some ten years later, the A. C. Network Analyzer made it possible to study load flow and transient phenomena on electric power systems. Along with the growth of electrical computers came the mechanical differential analyzers and more recently modern accounting practices have led to the development of specialized punch card digital computers that can be adapted to the solution of engineering problems. Although most of the computers in use today were primarily developed for the study of electric generation, transmission, distribution, and utilization problems, they along with the digital computers, have been used successfully in solving machinery problems, fluid flow studies, guided missile problems, vibration and stress studies, and many others.

In still more recent years, the electronic differential analyzer

Engineering Research and Machine Design Committee

has become very popular in engineering organizations. It will solve many of the problems formerly assigned to the mechanical differential analyzer; it has the advantages of shorter set-up time and speed of solution. The electronic differential analyzer offers an effective means for studying the design of industrial drives both before and after they are installed in the field. It has been demonstrated many times that the performance obtained from the computer representation compares closely with field experience. As a result, only the necessary components need be provided in the design of mechanical and electrical systems, thereby reducing first costs and saving valuable production time during the initial installation of complicated drives with complicated regulators. In this manner, many of the inevitable problems which accompany engineering progress can be solved and this can and will result in benefits to the paper industry.

"Performance and Design of Paper Stock Mixers," by J. Y. Oldshue and A. T. Gretton, Mixing Equipment Co., Inc., Rochester, N. Y. In the industrial application of fluid mixers, one of the most important considerations is the definition of the process performance the mixer is to achieve. Unless quantitative definitions exist, it is impossible to predict what effect the mixer and stock chest components will have on the paper mill system. The lack of such quantitative definitions accounts for the wide variations in mixer designs proposed by various sources.

An extensive experimental program was initiated to set up these quantitative definitions. Data were taken in 18-in. through 35 ft. diameter tanks. A 40 hp. variable speed mixer in a 12-ft. diameter tank in an actual paper mill installation provided the data to establish the basic process definitions. The process definitions established are complete uniformity, complete motion, partial volume uniformity, motion at the pump suction, and batch blending time.

These definitions supplant previous qualitative terms such as "mild blending," "mixing," and "uniformity," which do not have the rigorous definitions that ensure accurate mixer design.

The development of these quantitative definitions is given in terms of the data obtained in the development program. The various definitions are discussed for the common tank shapes and mixer designs used in paper mills, including vertical cylindrical tanks, rectangular tanks with or without midfeathers, and top-entering and side-entering mixers.

Various mixer variables such as impeller position, impeller to tank diameter ratio, and impeller type were studied in detail. It was established that the mixer performance is a function of the fluid regime produced in the stock chest and

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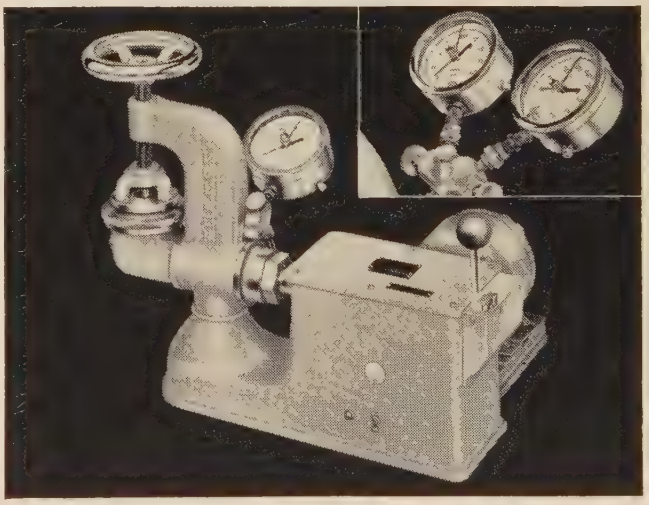

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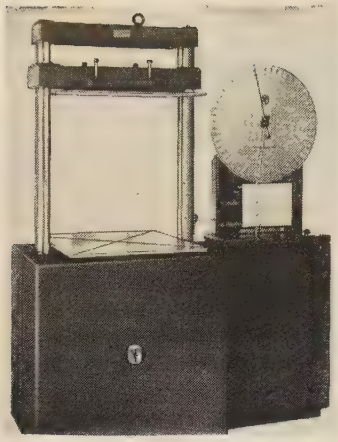

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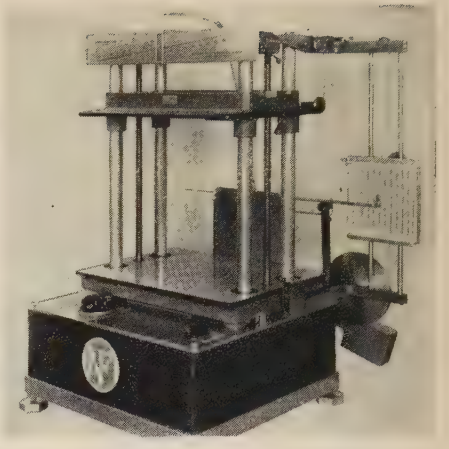

the effect of these mixer variables to achieve the desired fluid regime has been established. The effect of stock type and stock consistency has also been established.

With these quantitative definitions, it is possible to predict what action a mixing chest will have on the paper mill flow diagram. Examples of actual application are given.

Mill Planning and Economics Session

Roland A. Packard, Consultant, Hopkinton, Mass., was chairman of a session on Mill Planning and Economics. This session consisted of a panel discussion, moderated by Howard Baumgarten, Parsons & Whittemore, Inc., New York, N. Y., and was a sequel to a panel on problems in mill expansion held at the Ninth Engineering Conference in 1954.

The members of the panel were: J. F. O'Neill, International Paper Co., who discussed taxation; Ward D. Harrison, Riegel Paper Corp., on research development; William Hart, Crown Zellerbach Corp., on organization planning; Neil McLeod, The Institute of Paper Chemistry, on marketing; Albert Donohue, Kidder-Peabody Co., on finance; Harold G. Ingraham, Chas. T. Main, Inc. and John A. McPherson, Mosinee Paper Mills Co., who were the discussion leaders last year sat in on the panel discussion to give continuity.

In his introductory remarks, Mr. Baumgarten said that as the framework for the discussion the five panel members would present their ideas on the subjects assigned to them.

William Hart, Crown Zellerbach Corp., in a discussion of organization planning, defined this as the grouping of the activities of the company so that they may be logically assigned and effectively carried out. The speaker said that this required organization planning and stressed the fact that "people are the key to organization."

Discussing the factors which are part of organization planning, Mr. Hart said that these included (1) avenues of advancement, (2) promotional ladders, (3) job duties and responsibilities, (4) advancement policies. The speaker stressed the fact that all these were necessary for the development of personnel to assume greater responsibilities in the organization.

Discussing the organization planning necessary when a corporation decides to expand its production facilities the speaker said that a number of problems immediately arose including (1) what additional management positions must be created, (2) what would be the effect on supervision in various segments of the company, (3) what would be the relationships of the positions in terms of duties and responsibilities and levels of supervision? The speaker said that the answers to these questions determine the desired organizational framework.

In his discussion, Mr. Hart used the example of a company manufacturing pulp and paper which decides to add a new paper machine to double the capacity of the mill.

Discussing the marketing aspects involved in mill expansion Neil McLeod, The Institute of Paper Chemistry, stressed the fact that a successful mill expansion program must have as its basis a correct market analysis, and emphasized that any capital expenditure must be predicated on some type of appraisal of the future which includes market analysis.

The speaker discussed the impact of technological developments made through research which resulted in the development of a new item. In this case, Mr. McLeod pointed out that this would require an important promotional effort to introduce and sustain the new item and to sell it at a correct price.

Another factor which Mr. McLeod discussed was the marketing problem involved in determining the break-even point of the new production facilities involved in the expansion program.

After discussing a number of questions which needed to be answered the speaker said, "Finally, the break-even point is governed by anticipated sales volume which in turn becomes the function of the sales price." In this connection the factor of competition is involved as well as current and future supply and demand factors affecting the market.

In discussing the importance of research in pulp and paper mill expansion, Ward D. Harrison, Riegel Paper Corp., said, "Research is popular today in American industry because it has proved time and again that it can develop new products and improve old ones. Moreover, one company after another reports that from 50% to 75% of its current sales now comes from products which didn't even exist 15 years ago. This progress would be impossible without research."

Mr. Harrison gave two examples of research in connection with the expansion of production facilities. The first example concerned a company which had decided to expand its pulp production. Mr. Harrison said "before proceeding, two important questions had to be determined in the research laboratory—(1) could a pulp be made from southern wood that would be strong enough to meet requirements, and (2) could pulp be made from the wood supply that would be bright enough to meet specifications. As a result of research and experimentation a process for using chlorine dioxide was evolved which not only was extremely successful in actual operation but has been developed further by us and others to become the current standard method of design for new bleach plants. This was an example of how research gave us the answer to what we could expect before the actual expansion program was started."

The second example given by Mr. Harrison was a company which desired to improve formation on a cylinder paper machine. In this case the speaker showed samples of the new product which were developed through research.

In conclusion, Mr. Harrison said, "the word research is old, but as a force in the world it is very new and is changing the world before our very eyes."

In discussing the financial aspect of pulp and paper mill expansion, Albert Donohue, Kidder-Peabody Co., analyzed the factors involved in the long-term financing of a paper com-

Mill Planning and Economics Committee

pany. Mr. Donohue stressed the fact that the factors involved in long-term financing were entirely different from those concerning short-term financing. In this connection the speaker said that it would be a mistake for corporate executives to use short-term loans from commercial banks for long-term needs if long-term money can be obtained without paying a substantially higher interest rate.

The speaker said that the negotiation of the loan is the simplest and least expensive way of financing, and added that much of the current long-term financing is being done by private placement with insurance companies or other institutional investors. In this connection the speaker said that the maturity of such loans is usually 15 years although it may be longer depending upon the earnings record and financial condition of the company. Repayment is effected by a sinking fund to retire the entire issue by maturity.

The speaker said that mortgage loans are not very different from unsecured loans. However, he pointed out that the interest rates on mortgages probably would be higher although the terms may be somewhat easier but not so much money could be borrowed on a mortgage as on an unsecured loan.

The speaker also mentioned the use of "sales lease-back transactions" which he said are becoming increasingly popular.

The speaker explained that rent charges paid to the buyer with fixed assets in a sale-lease transaction represents the payment of the sales price with interest on the unamortized balance of the sale price. The entire rental payment is considered deductible for tax purposes. In such a transaction the speaker emphasized the fact that the company which sells and leases back its fixed assets loses any chance to benefit from future depreciation of the fixed assets unless it is able to negotiate a repurchase option. These sale lease-back transactions are usually for a period of from 10 to 25 years, during which time the complete amortization of the investment is affected.

Referring to the "how, when, and why" of tax deductions, J. F. O'Neil, International Paper Co., suggested various internal factors such as probable profit picture during the life of the equipment, whether tax money saved in early years can be put to profitable use in the business, and factors imposed by the tax laws.

In the second part of his presentation, Mr. O'Neil discussed the various methods of writing off depreciation and of classifying the assets subject to depreciation.

Steam and Power Session

The final session of the conference on Wednesday was the Steam and Power discussion.

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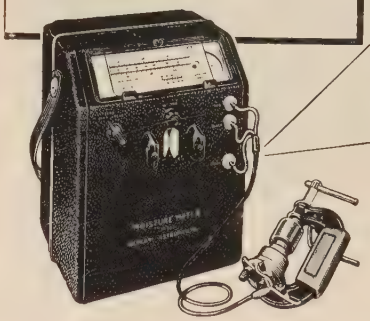

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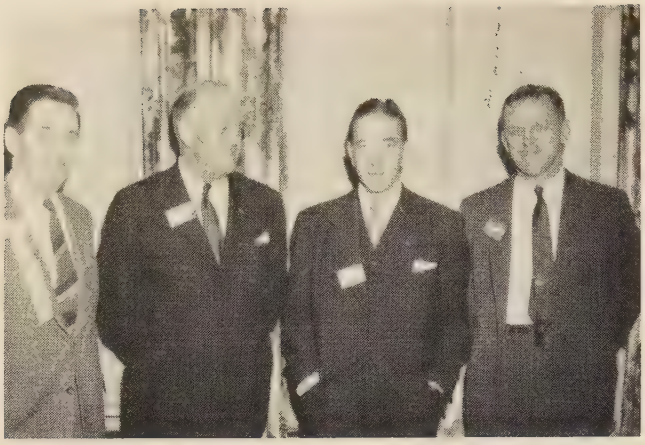
At this panel discussion, N. H. Mailhos, Brunswick Pulp & Paper Co., in the absence of R. C. Ridings, Container Corp. of America, presented a paper prepared by Mr. Ridings on "Cold End Boiler Corrosion—Oil Firing." The summary of this paper is as follows: factors in the corrosion problem while buying bunker C fuel oil are: (1) it definitely includes stacks and boiler casings; (2) it may be expected to follow plugging operations and hygroscopic deposits; (3) it presents special problems to personnel's health and clothing while working on the fire side of the boiler; and (4) it is not necessarily absent because of initial trouble-free operation when first burning oil.

Edmond L. Smith, Paper Mill Equipment Department, Combustion-Engineering, Inc., presented a paper on "Gas Side Corrosion." In this paper, Mr. Smith pointed out that: (1) use of steam tempering coils to raise the temperature of the air prior to entrance to the flue gas air heater; (2) air recirculation; (3) higher feedwater temperatures in the case of economizers; and (4) gunniting of stacks and breeching where possible, or by the alternate use of a lime wash on breeching." In conclusion, the author said: "In general, and insofar as design may be concerned, we recommend the use of sufficient soot blowers in the air heater sections of boilers where any deposits, however slight, would be apt to occur. We have found also that the use of larger diameter tubes in the cool end of a boiler will have the natural effect of cutting down on the velocities, thereby reducing heat transfer rates and producing higher metal temperatures. As we pointed out earlier, corrosion does not necessarily hinge directly on the final exit gas temperature if any one of the methods mentioned before can be used to sustain a higher metal temperature, or one that would be above the dew point of the flue gas.

The summary of the paper by R. M. Hardgrove, Babcock & Wilcox Co., on "The Use of Additives to Reduce Airheater Plugging and Corrosion" is as follows: The solid material pres-



J. D. Lyall, Armstrong Cork Co.; A. D. Bruce, University of Houston; K. R. Benedetson and Stephen Chase, Jr., Champion Paper & Fibre Co.

ent in the flue gases is an important factor in corrosion and deposits in airheaters. Lime, dolomite, and magnesia are commonly available, and they are effective as solid material additives to reduce corrosion and deposits. Economic evaluation of this method for alleviating the problem will vary with different plants, but it appears that costs of using these additives are nominal, and we would expect that their use will be increasing.

David C. Edmiston, Sr., Southland Paper Mills, Inc., discussed some of the problems in his mill with tubular air heaters. Mr. Edmiston said that when the mill of the Southland Paper Mills, Inc., was built at Lufkin, Tex., in 1939, the original plant had three gas-fired boilers with tubular air heaters, and he said "up to the present time, we have not cleaned or replaced a tube, or otherwise spent a penny on maintenace of these heaters. Later, when the production facilities were suspended in 1946, two new boilers with tubular air heaters were installed and early this year we lost the air heater tubes in the boilers installed in 1946." This was due to cold and corrosion caused by operating below the dew point. In order to gain all the efficiency possible in an air heater, Mr. Edmiston explained that the temperature of the flue gases are lowered. "However," he added, "when you lower the flue gas temperature, you take a chance on hitting the dew point during some operating conditions. We forgot to consider two very practical factors—(1) increased efficiency of the boilers was gained most through increasing the size of the air heaters; (2) the intake of outside air to F. D. fan would lower the tube metal temperature of the air heater tubes."

Tuesday Evening Dinner

On Tuesday evening, November 8, the delegates attended a reception offered by Southland Paper Mills, East Texas Pulp & Paper Co., and Champion Paper & Fibre Co., following which an official dinner was held. J. D. Lyall, Engineering Division chairman, introduced W. L. McHale, Southland Paper Mills, who acted as toastmaster.

During and after dinner the delegates were entertained by the "Four Flats and a Sharp," a local semiprofessional vocal quartet and pianist.

Engineering Division Luncheon

On Wednesday, November 9, the annual Engineering Division Luncheon was held under the chairmanship of John D. Lyall, Armstrong Cork Co., Lancaster, Pa., general chairman of the TAPPI Engineering Division. Mr. Lyall introduced the committee chairmen and officers of the division. R. W. Kent, Champion Paper & Fibre Co., Pasadena, Tex., presented the division with a cowbell on behalf of the local arrangements committee, for use at future meetings.

Mr. Lyall made a plea for more active participation in committee activity by delegates to the conferences. The chairman pointed out that psychological studies have proved that ideas are best generated during group activity, and that TAPPI committees are the best place for this type of stimulation. During the 10 TAPPI Engineering Conferences a total of over 4000 delegates have heard more than 225 papers presented, virtually all as a result of work by the 13 committees of the division.

Mr. Lyall then presented a plaque to W. C. Bloomquist, retiring secretary of the division, on behalf of the division's committee officers, in recognition of his service to the division.

Karl M. Bendetson, Champion Paper & Fibre Co., Pasadena, Tex., introduced Lieut. Gen. A. D. Bruce, president of the University of Houston, who addressed the delegates on the subject of "The Status of Engineering—National and Local." The full text of Gen. Bruce's address appears elsewhere in this issue of *Tappi*.

Mill Visits

On Thursday, November 10, the delegates visited pulp and paper mills in southeast Texas.

Champion Paper & Fibre Co., Pasadena, Tex., was toured by 113 delegates, 92 visitors viewed the mill of East Texas Pulp & Paper Co., Evadale, Tex., and Southland Paper Mills, Lufkin, Tex., was visited by 37 delegates.

Ladies' Program

A program was also arranged for the 112 ladies who were present, including a fashion show, a coffee party, and other events.

Tenth Plastics-Paper Conference

The Tenth Plastics-Paper Conference of the Technical Association of the Pulp and Paper Industry was held at the Brooklyn Law School, Brooklyn, N. Y., Nov. 14 and 15, 1955. A total of 253 delegates attended the meeting, which was sponsored by the TAPPI Plastics Committee, J. C. Pullman, American Cyanamid Co., New York, N. Y., *Chairman.*

The general chairman of the conference was H. F. Mark, Brooklyn Polytechnic Institute, Brooklyn, N. Y. Walter L. Hardy, Foster D. Snell, Inc., New York, N. Y., was in charge of the technical program and of publicity, and Richard Lindenfelser, American Cyanamid Co., Stamford, Conn., was in charge of local arrangements.

W. C. Bloomquist, retiring secretary of the Engineering Division being presented a scroll by J. D. Lyall, Engineering Division chairman

Mill Instrumentation and Control Committee

The subjects of the four technical sessions of the conference were: "Fibrous Materials for Laminates," "Resins Employed in Laminates," "The Pulp and Paper Industry Speaks on Its Plastics Requirements," and "Polyethylene Extrusion Coating." The meeting also included an official luncheon at which A. B. Clunan, Container and Packaging Division, U. S. Dept. of Commerce spoke on "Statistics of Packaging."

Brief reports of the papers presented during the technical sessions are given in the following account. The full text of the papers will be published in future issues of *Tappi*.

Technical Sessions

Fibrous Materials for Laminates

Paul M. Goodloe, Brown Co., Berlin, N. H., was chairman of the first session, on Monday morning, November 14. The following are digests of the papers presented:

"Discussions of Some Factors Influencing the Crazing Tendency of Laminates," by Hanns F. Arledter, Hurlbut Paper Co., South Lee, Mass. The crazing tendency of laminates is well explored by the industry. Literature references about this difficult and complex subject are, however, scarce.

Some studies were made concerning the influence on the crazing tendency of resin amount and resin distribution in the overlay, the decorative printed paper, and the laminating structure.

The contributing factors on crazing tendency of the overlay, the decorative base paper, the core stock in connection with laminating pressure, time, temperature, resin pre-cure, and other elements were discussed.

"The Forming Machine—Its Use in Sheet and Pre-Forming Operations," by P. E. Fuerst, the Forming Machine Co. of America, Bound Brook, N. J., and Frank Hayes, Noble & Wood Machine Co., Hoosick Falls, N. Y. Since the delivery of a paper on the Forming Machine at the TAPPI Plastics Meeting in 1953, both companies have conducted hundreds of pilot plant and commercial tests on the use of the forming machine for various purposes. The uses of the forming machine in the pulp industry were described.

A list of the fibers which have been successfully formed on the forming machine was given; this list included several items which are difficult to form as a continuous mat on conventional equipment.

The forming machine works on the principle of pressure instead of vacuum, thereby permitting the production of heavier, dryer, more uniform sheets, or boards than is possible with conventional equipment. The normal difference in lengthwise and crosswise flexual strength are practically eliminated for materials produced by the forming machine.

The paper concluded with a description of the versatility of operations which can be obtained through the use of this type of equipment.

"Some Properties of Polyester Laminates Reinforced with Cellulosic and Glass Fibers," by T. J. Welsh, J. J. Coleman, and L. P. Wenzell, Celanese Corp. of America, Charlotte, N. C. Most available data on polyester resin laminates are concerned with types reinforced with all glass fibers. With the two fold purpose of examining further uses for our fibers and plastics in this field, Celanese has undertaken research to examine some of the properties of polyesters reinforced with cellulosic fibers in combination with glass.

Data reported in this paper were confined to the use of bleached kraft pulp and cellulose acetate staple in combination with glass fibers. A number of laminates were made up with various combinations of these fibers and tested for tensile strength, flexual strength, notched Izod impact, and moisture absorption. All mats were made on a Forming Machine Co. of America, pressure-type papermaking unit. All laminates were prepared by the wet layup technique using Celanese MR-28 type polyester resin.

Tensile and flexual strengths of the laminates reinforced with 30% kraft and 10% cellulose acetate staple (weight proportion) with glass, or 30% ratio of kraft to glass or lower, were similar to all-glass mat laminates, where resin contents were comparable. Main advantage would be lower cost for reinforcing fibers. In addition to this the mat could be handled without bonding agents. Also mats made up with the acetate were noted to wet out more readily, were more pliable, had better uniformity, and gave good surfaces without the use of a surfacing mat.

From these initial discoveries, it is concluded that lower-priced serviceable polyester laminates may be contemplated using cellulosic fibers in combination with glass for the reinforcing.

"Factors Affecting the Electrical Properties and Fire Resistance of Phenolic Paper Laminates," by Myer Ezrin, Monsanto Chemical Co., Springfield, Mass. Small amounts of atmospheric moisture absorbed by phenolic resin treated paper before laminating has such a great effect on the 60-cycle dielectric properties of the laminate that it is the prime factor determining these properties. Under conditions which avoid absorption of atmospheric moisture before laminating, the slope of the curve of dissipation factor or dielectric constant versus volatile content of the laminate is relatively small. If the volatile content is increased slightly by allowing the treated paper to absorb moisture, the increase in the value of the 60-cycle dielectric properties is much greater than for an approximately comparable increase in volatile content resulting from a shorter drying time. This effect is shown to be a function of how thoroughly the paper is impregnated by pretesting the paper with a dilute solution of a low molecular

Group at the Tenth Plastics-Paper Conference held at the Brooklyn Law School

W. R. Penrod, Dilts Machine Works, E. C. Bernhardt, E. I. du Pont de Nemours & Co., Inc.; R. C. Sturken, Frank W. Egan & Co.; K. A. Arnold, St. Regis Paper Co.; and J. J. Sullivan, Lowe Paper Co.

weight melamine—formaldehyde resin. Electrical properties other than those at 60 cycles, particularly after water immersion, are also improved as a result of the melamine resin pretreatment of the paper. In addition, the fire resistance is improved appreciably.

Resins Employed in Laminates

H. F. Mark, Polytechnic Institute of Brooklyn, Brooklyn, N. Y., was chairman of the second session, held on Monday afternoon, November 14. The four papers presented during this session are briefly abstracted below:

"Board Surfacing in Laminates," by R. Lindenfelser and H. P. Ledden, American Cyanamid Co., Stamford, Conn. An improved method was described for applying a decorative, protective, plastic surface to low-cost structural boards by means of low-pressure laminating techniques. The development of two new modified triazine resin varnishes was demonstrated to overcome the chief disadvantages of the previous commercial surfacing methods.

Standard decorative print stock and overlay paper are treated with experimental resins PDL-1-2247 and PDL-1-2352, respectively, on conventional equipment. The treated papers are completely dry and nonblocking and may easily be laminated to the surface of hardboards such as Masonite or low density particle boards such as woodwaste or chipboard. A satisfactory curing cycle is 10 min. at 250 p.s.i., 300°F. No adhesive or balance sheets are necessary. The same technique is also suitable for a new process, viz., the production of a fancy wood veneer faced lumber core or plywood assembly surfaced with a single resin-treated transparent overlay sheet. The entire assembly, including cross-banding plies, may be bonded and cured in a single low-pressure operation in conventional laminating or plywood presses.

Surface properties of representative boards, finished with the new resins approach those of standard decorative melamine laminates. Several possible applications were outlined and the economics of the process were discussed.

"Titanium Organic Polymers and Their Use with Fibers," by H. C. Brill, E. I. du Pont de Nemours & Co., Wilmington, Del. Titanium organic compounds in the form of esters, acylates and chelates have been made available in semi-commercial quantities in the past five years. They are characterized by a Tl—O—C bond rather than a direct Tl—C connection. Most of the compounds are readily soluble in hydrocarbon, alcohol, or chlorinated organic solvents. With the exception of the water-soluble chelates, they hydrolyze at various rates in moist air to form polymeric forms of titanium oxide.

Certain of the chelates are soluble and stable in water solution. They react readily with various starch or cellulose derivatives to gel, precipitate or cross link these compounds. They impart some water resistance to these compounds.

When the water-soluble chelates are added directly to dry paper, very little change in the physical properties occurs. The best field of investigation for use of these chemicals in paper is apparently in secondary effects such as speeding ink dry, controlling strike-in of coating, improving plasticizer retention, gelation of starch or other hydroxy compounds, curing silicone resins, coatings, etc.

"Reinforced Polyester Resins," by H. L. Gerhart, Pittsburgh Plate Glass Co., Springdale, Pa. The family of resins comprising the polyester class has, in recent years, became very large. The membership embodies a variety of different types having in any one case, broad ranges of properties:

Flexibility—rubbery soft to glassy hard
Consistency—thin liquid to viscous syrup or solid
Cure time after catalyzation—instantaneous to hundred hours

Chemical resistance—water soluble to complete insolubility. Still other types can be made to be nonburning, light sensitive, foaming, air curing, etc.

Brief reference to the chemistry of these resins will indicate the reasons for this broad latitude in properties; recent discovery of unique inhibitors, catalysts, and accelerators have attended the curing conditions to meet every practical plant requirement.

Polyester resins without reinforcement form strong cast structures suitable for glazing application such as in aircraft. High structural strength is obtained by reinforcement with strong fibers such as glass. A comparison indicates the relative reinforcing action of fibers of many types.

Paper is the lowest cost practical reinforcing filler giving medium strength structures.

Many fabrication techniques are applicable to commercial uses; specific applications were illustrated.

Certain improvements desirable in cellulosic fibers for future growth as reinforcement media were delineated.

"Epoxy Resins and Their Use with Fibers," by B. E. Goddard, Bakelite Co., New York, N. Y. In fields long dominated by polyesters, epoxy resins are making striking advances and can be considered the major contender for reinforced plastic applications where high strength, electrical properties, and chemical resistance are important.

P. M. Goodloe, Brown Co. and H. C. Brill, E. I. du Pont de Nemours & Co., Inc.

Epoxy resins reinforced with glass, synthetic fibers, textiles, mineral fibers, and paper, have in general, static and dynamic mechanical strengths superior to phenolics and polyesters especially when tested in edge-wise compression, this latter test being a measure of bond strength.

Wet and dry epoxy laminating techniques were discussed and typical mechanical, electrical, and chemical resistance properties were presented. Successful applications of reinforced epoxies, such as pipe, tanks, tooling, repair systems were also discussed.

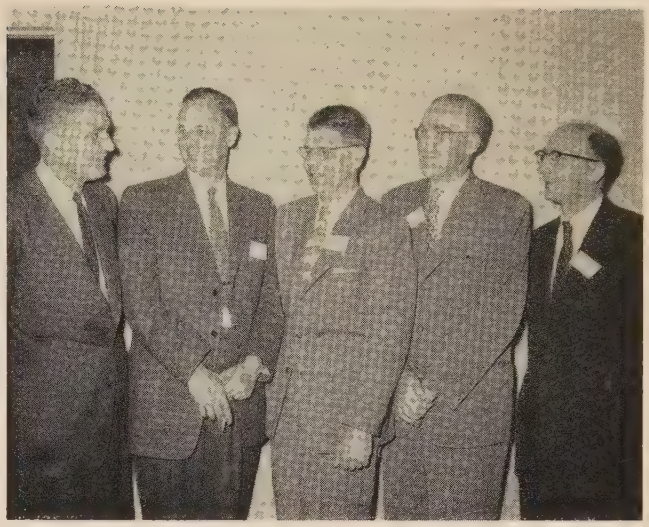
The Pulp and Paper Industry Speaks on Its Plastics Requirements

The third session was held on Tuesday morning, November 15, under W. Stickel, Texon, Inc., South Hadley Falls, Mass., *Chairman*. Representatives of four segments of the paper industry discussed their particular plastics requirements. Summaries of these discussions follow.

"Specialty Papers," by J. E. Helms, Marathon Corp., Menasha, Wis. Increasing demands for specialty packages occasioned by an ever-increasing variety of products indicates the need for improved plastic materials for use on paper. The current growth of the packaging field indicates that a market for plastics of considerable volume is a future prospect. In the selection of the proper plastic to be used in paper packages, not only the inherent properties of a plastic as it relates to functional properties but also the properties affecting the physical application of the plastic to the paper and used by the consumer, must be taken into consideration. None of the commercially available plastic materials, when compared for their properties of greaseproofness, water vapor proofness, heat seal, gloss, ease of application, and functional properties, seem to be satisfactory in all respects. The improvements and properties sought for a number of existing plastic materials as hot melt, dispersion, and solvent coatings for paper were discussed. The plastic materials include vinyls, cellulose derivatives, protein-type resins, acrylic and methacrylic esters, synthetic rubbers, polyester resins, epoxy resins, natural and synthetic gums and waxes. Several recent developments are described which point the way toward improved packaging materials of the future.

"Greaseproof and Glassine," by R. T. Nazzaro, Westfield, River Paper Co., Russell, Mass. Greaseproof and glassine represent grades of paper with both unusual and unique characteristics prepared from special pulps with a high degree of refining and special papermaking techniques. The treatment of the fiber in the manufacture of greaseproof and glassine brings about what might be called a cellulosic gel which upon drying develops a sheet having a natural resistance to the pentration of greases and oils. The greaseproof is prepared on a fourdrinier machine and is converted into glassine by means of supercalendering. There are both opaque and transparent grades. The calendered sheet has a very dense surface with high gloss and is very resistant to the passage of air.

V. T. Stannett, College of Forestry, State University of New York; J. C. Pullman, American Cyanamid Co.; A. J. Winchester, TAPPI; and W. L. Hardy, Foster D. Snell, Inc.



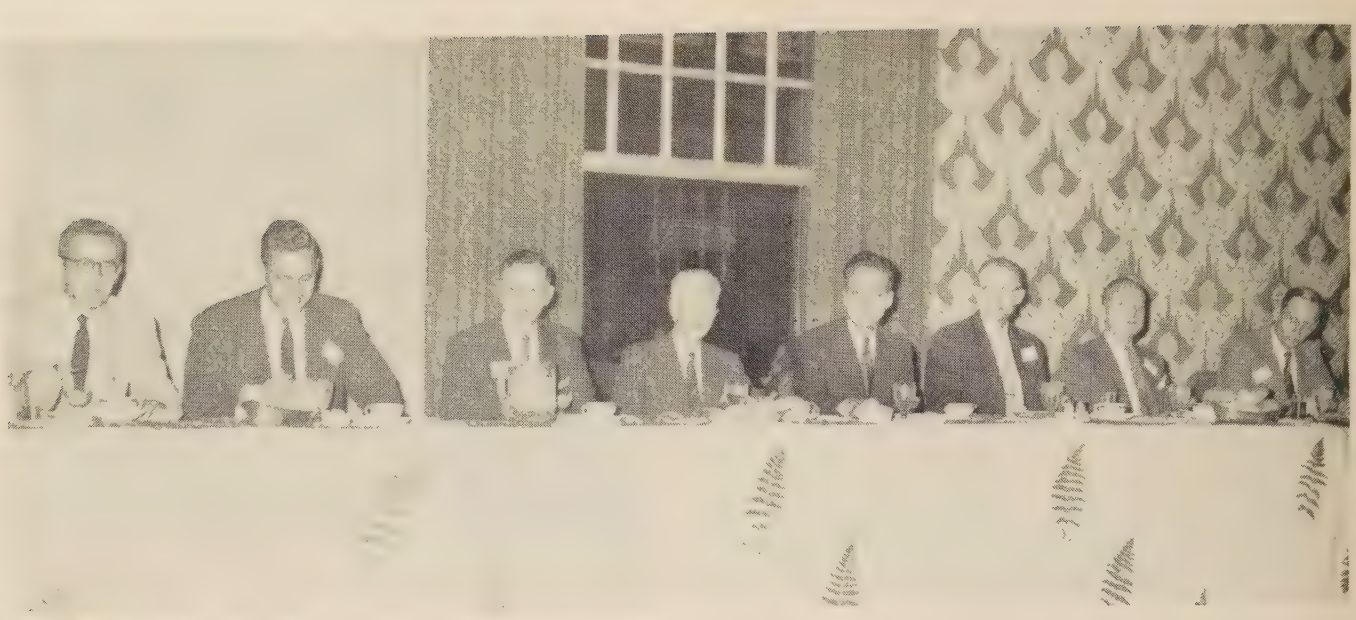
W. N. Steckel, Texon, Inc.; A. T. Luey, The Boxboard Research & Development Assoc.; J. F. Helms, Marathon Corp.; H. Maeder, Dixie Cup Co.; and R. T. Nazzaro, Westfield River Paper Co.

For various and specific reasons, glassine and greaseproof papers make ideal bases for conversion by means of lacquer coatings, hot melt coatings, polyethylene coatings, surface waxing, wax laminating, and other special conversions of the glassine and greaseproof such as release treatment, mildew and moldproof, etc. All of these modifications impart special properties to the glassine and greaseproof such as release characteristics, marked improvement of strength, heat sealing, and excellent water vapor resistance.

Glassine and greaseproof represent flexible protective barriers having the lowest unit cost per unit of protection. They are carefully controlled and for this reason the sheets can be adapted practically to any special end use, especially through one or more of the modifying methods. A review of the means by which some of these special problems are met is an interesting account of the high degree of specialization employed by the industry.

"Boxboard," by A. T. Luey, The Boxboard Research & Development Association, Chicago, Ill. The author recommended the development of chemicals that will improve the normal characteristics of paper and paperboard as opposed to the development of specialties. A list of paperboard qualities that would be desirable to improve by means of chemical additives was given with a few comments regarding their economic value. Among these are stiffness, tear, fold, brightness, printability, and offset elimination.

"Cups and Containers," by Henry Maeder, Dixie Cup Co., Easton, Pa. The steady growth of the cup and container industry from its start approximately half a century ago when cups were hand made from sheets of paper purchased from the local paper merchant to the present highly automatic production centers which consume several hundred thousand tons of paper per year, speaks well for the utility, economy, and appeal of its products. Future growth will depend largely on the development of new markets. Already new uses for these products, high speed equipment for filling, sealing, vending, and using them are placing new demands on cups and containers. To fill these new requirements, the industry must develop new raw materials, improve the quality of existing raw materials, and develop new techniques for converting them.



The head table at the Paper-Plastics Conference luncheon: A. J. Winchester, TAPPI; W. N. Stickel, Texon, Inc.; J. C. Pullman, American Cyanamid Co.; A. B. Clunan, U. S. Department of Commerce; W. L. Hardy, Foster D. Snell, Inc.; P. M. Goodloe, Brown Co.; R. C. Sturken, Frank W. Egan & Co.; and V. T. Stannett, College of Forestry, State University of New York

Raw material technical requirements must be considered from at least two viewpoints: converting requirements and end-use performance requirements. It will be our purpose to discuss some of the opportunities for the papermaker and the paper convertor from both viewpoints.

Paper has certain inherent advantages which are not economically found in other web materials. Paper also has certain deficiencies which can be minimized or overcome by the use of chemical modifiers, resins, and plastics. The economical and technically sound union of the two is imperative if we are to successfully compete with molded plastics, plastic films, and metal foils. Part of the answer lies in developing good factual data about the paper-plastic combination; part lies in the proper selection of materials and in the process for combining them. The cup and container industry cannot accomplish this alone. We need and request your assistance. It is to the mutual advantage of our industries that we enter into an active cooperative development program.

"Physical Properties of Papers Coated with Polyethylene by Extrusion," by Kenneth A. Arnold, St. Regis Paper Co., Deferiet, N. Y. In a flexible package, such as a multiwall bag, the shock resistance of the paper is of primary importance. Experience in packaging chemicals in bags containing a polyethylene-coated ply indicated the contribution of this ply to the shock resistance of the completed bag was considerably greater than indicated by any of the standard paper tests. In some respects, this experience is parallel to that with bags having all plies creped.

A complete study has been made comparing results of paper tests on uncoated and on polyethylene-coated kraft papers. The effect of varying the coating weight on these properties has also been determined. Increase of coated versus uncoated paper in test results of burst, tensile, and stretch are not appreciable. Increases in tear resistance and dynamic tensile strength through polyethylene coating are significant. Other types of shock or impact testers have also demonstrated that an appreciable contribution results from polyethylene coating.

"A Comparison of Polyethylene and Polyethylene Wax Paper Coatings," by John C. Rice and J. Joseph Sullivan, Lowe Paper Co., Ridgefield, N. J. A comparison was given of polyethylene and polyethylene wax coated papers. These coatings were compared from the standpoint of physical and chemical properties, cost, and operating problems. The use aspects of coated paper products were stressed.

Where moisture vapor transmission resistance, water resistance, and release properties are of primary importance, polyethylene wax coating show an economic advantage over polyethylene coatings. However, if greaseproofness or solvent resistance is required, polyethylene wax coatings are not satisfactory.

This is a new field and there are many other possible modifications of polyethylene which could show advantages where specific properties are desired.

"Polyethylene Extrusion Coating Equipment Design and Operation," by Ernest C. Bernhardt, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. The elements of the extrusion-coating operation were analyzed. The design of equipment needed to process the plastic material and bring it to the proper condition to give good adhesion to the substrate was discussed. Needs for extruder screw design, instrumentation, and controls were covered and the solutions of several typical operating problems were illustrated.

"Performance and Design Data of Cooling Rolls on Polyethylene Extrusion Laminating Machines," by William R. Penrod, Dilts Machine Works, Fulton, N. Y. The various considerations which enter into the design of a cooling roll for a polyethylene extrusion laminator were discussed.

It was shown how performance data from actual mill runs are used to determine the size and design of the cooling rolls. A typical heat transfer calculation showing the use of temperatures, areas and conductivities was made. Contrasted to this typical calculation is the effect produced by some of the variations required for other desired cooling conditions. A comparison was made of different roll shell materials and thicknesses. The importance of the velocity of the coolant was shown.

Some common cooling roll problems such as roll surface temperature gradient, structural strength, coolant temperature, and cleaning were discussed and methods of controlling or solving them reviewed.

Luncheon

The official luncheon of the conference was held on Tuesday, Nov. 15, 1955, at the Bossert Hotel, Brooklyn, N. Y. J. C. Pullman, American Cyanamid Co., New York, N. Y., general chairman of the conference, introduced the persons seated at the head table and called upon Walter L. Hardy, Foster D. Snell, Inc., New York, N. Y., to introduce the guest speaker A. B. Clunan, chief, Flexible Container Branch, Container

and Packaging Division, Dept. of Commerce, Washington, D. C.

Mr. Clunan expressed the sincere regrets of C. A. Lewis, director, Container and Packaging Division, U. S. Dept. of Commerce, Washington, D. C., who was prevented by illness from addressing the conference as scheduled.

A. B. Clunan, Container & Packaging Div., U. S. Dept. of Commerce

Mr. Clunan's subject was "Statistics of Packaging." Emphasizing the magnitude of the packaging business today, the speaker stated that various sources estimated it at 10, 12, and 15 billion dollars annually, of which over one billion dollars represents the flexible packaging business alone. Mr. Clunan presented statistics on the volume of business in the various subdivisions of flexible packaging, and discussed the future potential of the packaging industry. The present annual consumption in this country is 1500 packages per capita. The future of this industry may be readily visualized when we realize that the population is expected to reach 190 million by 1965.

Twelfth Agricultural Fibers Conference

The Twelfth Agricultural Fibers Conference was held at the Stratford Hotel, Alton, Ill., on Oct. 13–14, 1955. Thirty-two committeemen and guests, representing nearly all of the strawboard mills were present. E. R. Carpenter of the Weston Paper & Mfg. Co., Terre Haute, Ind., presided as chairman, Thomas F. Clark of the Northern Utilization Research Branch of the Agricultural Research Service, Peoria, Ill., acted as conference secretary.

Carl Krancher of the Alton Box Board Co. welcomed the group to Alton and R. G. Macdonald, Secretary-Treasurer of TAPPI, gave a brief talk about the relation of the committee to the national organization. He reviewed the fine work of Samuel I. Aronovsky of the Northern Regional Research Laboratory who organized the committee and led its activities since its inception. The committee was urged to participate in the general association work and not restrict its interest to strawboard mill problems.

A. J. Ernst of the Northern Utilization Research Branch, Peoria, Ill., reported for the Task Committee on Fundamental Research Studies. This report will be published later in *Tappi*. Mr. Ernst pointed out that chopped straw produced somewhat better straw pulp than whole straw. More active alkalies produce lower yield. Lime cooks produce good results. The flat crush test depends on fiber distribution.

At the business meeting W. L. Cassiday reporting for the nominating committee proposed E. R. Carpenter for chairman, Thomas F. Clark, vice chairman, and Fritz Gruenwald, Consolidated Paper Co., Monroe, Mich, secretary.

R. F. Burns, Jr., Weston Paper & Mfg. Co., Terre Haute, Ind., presented a very interesting progress report of the Task Committee on Mill Data Exchange. Samples of five mills were distributed. Corresponding data were reported for precooking of straw, amount of straw per cook, number of fills per cook, amount of water per cook, chemicals used, steam pressure, length of cook, method of determining uniformity of cook, refining equipment used, cleaning processes, consistency regulation, paper machine steam requirements, production, drier data, press pressure, steam data, air data, moisture data, quality controls, concora, weight, caliper, and burst.

The conference members were guests of the Alton Box Board Co. at a luncheon. Roy Shaver, vice-president of the company, outlined some of the things that would be seen at the mill.

The afternoon of October 13 was devoted to a tour of the mill of the Alton Box Board Co.

On October 14 the morning session was devoted to a discussion of details of the mill visit and straw pulping problems. This general session was followed by meetings of the task committees.

Following are reports by T. F. Clark, acting secretary of the meetings that were held on Feb. 2, 1955, and April 29, 1955. Both reports relate to the TAPPI Fibrous Agricultural Residues Committee, the name of which was changed at this meeting to the Agricultural Fibers Committee.

Report of February 21 Meeting

The annual meeting of the Fibrous Agricultural Residues Committee was held at the Commodore Hotel, New York City, Feb. 21, 1955, 2 : 00 p.m. Eleven committee members and guests were present. In the absence of S. I. Aronovsky, who was ill, the meeting was opened by R. F. Burns of Weston Paper and Manufacturing Co. Following self-introductions, W. D. Maclay, chief of the Northern Utilization Research Branch, explained the present situation of the Branch with respect to research in the field of pulp and paper and the possibility for further research that might be of benefit to the strawboard industry.

In the following discussion Mr. Burns pointed out that while less straw was being used now than in 1949 the quality of the products had improved. All the straw, mostly wheat but including some rye straw, that was being pulped went into the manufacture of corrugating. If no protection was provided for straw stored outside in ricks a loss of about 10% could be anticipated over a 1-year period.

W. T. Lewis, Muskingum Fibre Products Co., pointed out that from his experiences effective preservation of straw ricks without resorting to chemicals was obtained by covering the top of the ricks with thresher-blown chaff to provide a natural watershed. Bright straw had been recovered from ricks so treated even at the end of 2 years.

Mr. Maclay inquired as to the relative economics of board production from straws and woods. According to Mr. Lewis the relationship was dependent upon the grades of the products but the quantities of raw materials required to produce 1 ton of paper would provide some basis for comparison; $1^3/_4$ tons of straw is roughly equivalent to one 2400-pound cord of softwood in producing 1 ton of paper.

While strawboard testing by the Container Laboratories dropped from 37.6% in 1949 to 16.6% in 1955, physical properties of the board had improved considerably in the same period. For example, crush test values for B-flute board increased from 27.6 to 42.1 p.s.i. during this same period.

In response to Mr. Maclay's question regarding the actual problems facing the industry, it was pointed out that with present practices about 3600 lb. of straw is required to produce 1 ton of paper whereas by the old lime process only 2800 lb. of straw was required. Further, cost of cooking chemical has increased from $1.00 to $5.00 per ton of paper or board produced. Increased yields therefore became a basic problem. This problem was discussed at some length with respect to possible investigation of several chemical and physical procedures as means for improving yields and economics in the production of straw corrugating medium. In considering any improvements, Schopper-Riegler freeness values of 450 to 500 are desired for cylinder machine operation and 440 or less for fourdrinier operation.

Mr. Burns referred to a TAPPI program of study previously set up as a basis on which further investigation might be initiated. The problems included:

1. Physical, chemical, and fiber characteristics (TAPPI No. 259)
2. Evaluation of pulps from residues (TAPPI No. 260)
3. Pulping characteristics and properties of resulting pulps (TAPPI No. 261)
4. Fiber losses, white water re-use, stream improvement (TAPPI No. 262)
5. Drainage rate, felting properties, and operating characteristics (TAPPI No. 263)
6. Evaluation of present test methods for residue products (TAPPI No. 264)

Inasmuch as committee members were not prepared to submit other problems for discussion, it was planned that the committee would meet again in the early spring at Terre Haute, Ind., at which time definite problems would be submitted for discussion and appropriate action.

The committee agreed that E. R. Carpenter and T. F. Clark should serve as acting chairman and secretary, respectively, until such time as more definite arrangements could be made.

At the request of the committee, Mr. Carpenter was to prepare a letter of best wishes for a speedy recovery to be sent to Mr. Aronovsky. This was signed by all those present.

ATTENDANCE

B. H. Bamer, Stone Container Corp., Coshocton, Ohio
R. F. Burns, Weston Paper and Manufacturing Co., Terre Haute, Ind.
E. R. Carpenter, Weston Paper and Manufacturing Co., Terre Haute, Ind.
R. P. Clark, Muskingum Fibre Products Co., Coshocton, Ohio
T. F. Clark, Northern Utilization Research Branch, USDA, Peoria, Ill.
C. G. Krancher, Alton Box Board Co., Alton, Ill.
L. J. Kucera, Minnesota and Ontario Paper Co., International Falls, Minn.
W. T. Lewis, Muskingum Fibre Products Co., Coshocton, Ohio
J. R. Little, Hinde & Dauch Paper Co., Sandusky, Ohio
W. D. Maclay, Northern Utilization Research Branch, USDA, Peoria, Ill.
R. A. Springer, Diamond Alkali Co., Painesville, Ohio

Report of April 29 Meeting

The 1955 spring meeting of the Fibrous Agricultural Residues Committee was opened at 9:30 a.m. April 29 at the Terre Haute House, Terre Haute, Ind. Acting Chairman E. R. Carpenter, Weston Paper and Manufacturing Co., presided. Twenty members and guests were present. The secretary's report of the February, 1955, meeting was read and approved.

Mr. Carpenter discussed the general purpose of the meeting, pointing out that several strawboard mills have converted to wood, others have closed down, and that at present only seven board mills were still operating on straw. This decline in numbers had come about even though the quality of strawboard had been improved in recent years. He felt that technological advances as well as other improvements in business practices would be necessary in order that the strawboard industry regain its previous position in the container board field.

Although it was recognized that the present name of the committee was entirely correct and representative of its objectives, the group felt that a more appropriate title with less emphasis on residues might be selected. The group was unanimous in approving a new title "Agricultural Fibers Committee." Even though in its broadest sense the title could include such crop fibers as cotton it was considered that with respect to the TAPPI organization the meaning was clearly defined and would present no conflicts.

Mr. Carpenter spoke of the desirability of reorganizing the committee in order to conduct its work more expeditiously. In doing this Mr. Carpenter had high praise for the work of S. I. Aronovsky, Northern Utilization Research Branch, and pointed out that there had been a tendency to let Mr. Aronovsky shoulder the major burden of the committee work. A motion was made by Carl Krancher, Alton Box Board Co., and seconded by B. Bamer, Stone Container Corp., that the officers of the committee consist of a chairman, assistant chairman, and secretary-treasurer, to be elected for a one-year term at the fall meeting, and that the officers advance to fill the vacancies created at the expiration of the chairman's term. This was approved unanimously. Mr. Carpenter appointed a nominating committee consisting of W. L. Cassiday, chairman, Alton Box Board Co., B. Bamer, and A. J. Ernst, Northern Utilization Research Branch, to report at the fall meeting.

It was moved by Mr. Cassiday and seconded by R. D. Shiflet, Weston Paper and Manufacturing Co., that the Agricultural Fibers Committee hold two technical sessions each year, spring and fall, rather than attempting to conduct business at the national meeting in February. The motion was approved.

In Mr. Carpenter's discussion on committee organization he pointed out that this committee had been lax in preparing monographs, standards, and other materials for persentation to TAPPI. It was his belief that more technological progress might be made if problems were assigned to task committees rather than standing committees. Mr. Bamer moved and Krancher seconded that projects be assigned to task committees and that committees be disbanded as their assignments were completed. The motion passed.

T. F. Clark, Northern Utilization Research Branch, reported on facilities available at the Northern Branch for research on pulp and paper. This report led to considerable discussion on the merits of a 10-in. paper machine in evaluating pulps that would be run subsequently on a mill paper machine operating at speeds of 350 ft. or more per minute. The Concora flat crush test for corrugating developed by the Container Corp. of America is considered essential for production control in all the strawboard mills. The cost of this unit is about $1600 and is available from Liberty Engineering. F. B. Grunwald, Consolidated Paper Co., reported that his firm no longer uses the ring crush test for control purposes.

R. M. Wilkinson, Alton Box Board Co., suggested that lists of testing facilities at each mill be prepared and that these lists be circulated for the mutual benefit of all strawboard mills. Because there was much interest in testing facilities available, K. R. Majors suggested that the equipment at the Northern Branch be listed and the list circulated among the various mills. A discussion of a program of information and sample exchange followed. Mr. Carpenter appointed Messrs. W. A. Lunsford, chairman, Consolidated Paper Co., and R. F. Burns, Jr., to conduct a letter survey of the strawboard mills regarding their interest in continuing the work of the Agricultural Fibers Committee and to prepare a questionnaire for those interested to cover the subjects of mill equipment, research facilities, and sample exchange all reports to be coded so as not to divulge the identity of the cooperating mills.

The next problem considered was that of the chemical and physical properties of straw pulps produced by different cooking chemicals and chemical concentrations. Mr. Carpenter commented that there were as yet no data available on this subject even at the Institute of Paper Chemistry. Mr. Ernst pointed out that such data as they applied to pulps for fine papers had been accumulated but not for strawboard. Mr. Krancher suggested that fiber size might have an effect on cooking and on freeness of resulting pulps and that physical properties of pulps might be correlated with freeness. Mr. Wilkinson added that removal of minus 100-mesh fines reduced the chemical consumption in cooking and that such removal had an effect upon the flat crush strength of the resulting papers. Mr. Krancher commented further upon the possible relationship of viscosity to cellulose chain length in pulps and the relationship of testing on a 10-in. slow speed (5 to 8 f.p.m.) paper machine to results obtained from mill-scale operations. Mr. Ernst pointed out that favorable correlation

had been obtained when tests were made with wood semi-chemical and bagasse pulps.

At this point C. E. Rist, Northern Utilization Research Branch, proposed the question "What is the product off the paper machines, what are the characteristics desired, and what are the major variables involved?" Mr. Carpenter replied that quality was the prime objective. Mr. Rist then inquired why and how might the chemical and physical properties of straw pulps be related to quality and runnability of corrugating media if operations subsequent to pulping but prior to machine formation are to change the characteristics of the pulps. Mr. Carpenter pointed out that pulp characteristics for forming quality board should be known before the pulp is made into a machine furnish. Mr. Bamer added that thus far strawboard manufacture has been a trial-and-error proposition and that fundamental information not now available is necessary in order to establish controllable mill practices and that such work was done in developing papers and boards from woods. After some additional discussion on this subject, Mr. Rist suggested that a task committee be set up to work with personnel of the Northern Branch to provide a statement of the several most important problems now facing the strawboard industry. This information was considered to be of value in indicating the type of research which could be used in planning a program that would be of maximum value to the industry. A subcommittee on Fundamental Research on Straw Pulp comprising Mr. Wilkinson, chairman, and Messrs. Carl Wynstra, Central Fibre Products Co., A. J. Ernst, and E. R. Carpenter was appointed.

Another problem of the industry is that of ideal flat crush strength for corrugating media. Apparently Concora values above 75 or 80 p.s.i. result in lower flat crush values for C-flute corrugating. When box-shop operators are questioned their only answer is uniformity in behavior on corrugators even though corrugating speeds might range from 350 to 550 ft. or more per minute. No formal conclusions were reached at this time.

The maximum raw material costs that the industry can absorb and still stay competitive were discussed next. With respect to wood one cord at about $20 plus chemicals at $8 to 10 will produce one ton of paper. Mr. Bamer pointed out that with wood at $10 per cord, straw at $13 per ton, and with 1.8 tons of straw yielding a ton of paper, the materials costs for container board are about the same from the two commodities. Also, storage of wood is less expensive than for straw. According to Mr. Carpenter the over-all material costs are about $28 to 30 per ton of product. Mr. Wilkinson emphasized the fact that there is a great difference in the manpower requirements of the two industries and that this has considerable bearing on production costs.

Mr. Carpenter announced that the fall meeting of the committee would be held at Alton, Ill. A tentative date of October 13 and 14 was set for this meeting. Mr. Krancher and other representatives of the Alton Box Board Co. will serve as committee on arrangements.

Following the luncheon the discussion centered around the advisability of seeking funds from TAPPI for the conduct of basic research, particularly with the cooperation of the Northern Branch. Mr. Rist explained how funds might be utilized for this purpose; that personnel might be hired to participate in actual work at the Branch under cooperative agreement. Mr. Burns, Sr., stated that he felt the committee would be derelict in its responsibilities if it were to overlook the advantages to be gained through cooperation with the Northern Branch. With respect to selection of an individual who might work with the Northern Branch it was agreed that it would be preferable to obtain an experienced individual not already associated with any of the operating mills because the present technical personnel have sufficient duties and responsibilities to require their full attention at the mills.

TAPPI Strawboard group assembled in front of the Alton Box Board Co. plant following its tour through the mill, October 13

On a motion by Mr. Burns, Sr., and seconded by Mr. Krancher, the secretary was instructed to write a letter of condolence to R. A. Springer, Diamond Alkali Co., who had had to leave Terre Haute the previous evening because of a death in his family.

ATTENDANCE

B. H. Bamer, Stone Container Corp., Coshocton, Ohio
G. C. Baron, Consolidated Paper Co., Monroe, Mich.
R. L. Booth, Weston Paper and Manufacturing Co., Terre Haute, Ind.
R. F. Burns, Sr., Weston Paper and Manufacturing Co., Terre Haute, Ind.
R. F. Burns, Jr., Weston Paper and Manufacturing Co., Terre Haute, Ind.
E. R. Carpenter, Weston Paper and Manufacturing Co., Terre Haute, Ind.
W. L. Cassiday, Alton Box Board Co., Alton, Ill.
T. F. Clark, Northern Utilization Research Branch, USDA, Peoria, Ill.
G. A. Dunlop, Dresden Div., Gaylord Container Corp., Dresden, Ohio
R. A. Eldridge, Weston Paper and Manufacturing Co., Terre Haute, Ind.
A. J. Ernst, Northern Utilization Research Branch, USDA, Peoria, Ill.
F. B. Grunwald, Consolidated Paper Co., Monroe, Mich.
C. G. Krancher, Alton Box Board Co., Alton, Ill.
W. A. Lunsford, Consolidated Paper Co., Monroe, Mich.
K. R. Majors, Northern Utilization Research Branch, USDA, Peoria, Ill.
C. E. Rist, Northern Utilization Research Branch, USDA, Peoria, Ill.
R. D. Shiflet, Weston Paper and Manufacturing Co., Terre Haute, Ind.
J. K. Vogel, Weston Paper and Manufacturing Co., Terre Haute, Ind.
R. M. Wilkinson, Alton Box Board Co., Alton, Ill.
C. J. Wynstra, Central Fibre Products Co., Quincy, Ill.

Ninth Alkaline Pulping Conference

The Ninth Alkaline Pulping Conference was held at the Hotel Patten, Chattanooga, Tenn., on Oct. 19–21, 1955. Three hundred and five persons registered. The local arrangements were handled by George B. Koons, J. K. Dyer, H. Hamby, and S. Richardson of Bowaters Southern Paper Corp., Calhoun, Tenn., and V. P. Owens of Combustion Engineering, Inc., New York, N. Y. M. B. Pineo, Brunswick Pulp & Paper Co., Brunswick, Ga., was chairman of the Alkaline Pulping Committee which sponsored the conference and David Wetherhorn Southern Paperboard Corp., Port Wentworth, Ga., was the program chairman.

PROGRAM OF WEDNESDAY, OCTOBER 19

J. J. Goss, Gaylord Container Corp., Bogalusa, La., was

Alkaline Pulping Committee

moderator of the first general session on Wednesday morning. The following papers were presented:

"The Practical Application of Statistics to Valveless Washing," by W. B. Simmons, Technical Director, St. Joe Paper Co., Port St. Joe, Fla. To find out about the variation in operation of a newly installed pulp washer, a statistical study was made of the relation of washer through-put to chlorine number, stock consistency, refiner inlet pressure, refiner motor loading, and unexplained factors. The solution of the problem confirmed the feeling of the speaker that the proper use of statistical method, supplemented by personal judgment will provide the information needed to make operating decisions.

"Problems Related to the Consumption of Na_2S and NaOH in Kraft Pulping," by Peter B. Borlew, Associate Technical Director, National Container Corp., Jacksonville, Fla. It was pointed out that only a fraction of the Na_2S but almost all of the NaOH is consumed during the cook. The contention that most of the Na_2S supplied by the white liquor is in excess of what is needed may activate the idea of low sulphidity cooks. From theoretical considerations it would appear that this type of cook promises the most economical use of Na_2S at high molar concentrations of Na_2S and NaOH, combined with a judicious recycling of black liquor and the use of dry wood.

"Digester Corrosion Studies," by F. Loschbrandt, Norwegian Pulp and Paper Research Institute, Skoyen, Norway. In this paper the speaker indicated that scale formation is induced by local conditions. In tests made no corrosion was noted at temperatures under 120°C. The formation of polysulphides at the corroding surface is the most important factor.

"The Role of Recycled Black Liquor in Sulphate Pulping," by Victor F. Mattson, Mead Corp., Chillicothe, Ohio. Recycled black liquor is widely used as a diluent in the preparation of sulphate cooking liquors. On examination of the organic components of a black liquor before and after re-cooking treatments indicated that these materials were relatively unaffected by re-cooking. Some further degradation of the lignin residues occurred and there was a small increase in the volatile acid content of the black liquor. The small amount of polysaccharic material in the liquor was only slowly destroyed on re-cooking. There was no evidence that re-cooking had any effect on the acidic materials derived from the carbohydrate portion of the wood. These results suggest that the re-cooking of black liquor could not affect an appreciable consumption of white liquor chemicals.

The results of a factorial experiment indicated that the effect of recycled black liquor is largely determined by the residual cooking chemicals it contains. The cooking value of the residual chemicals was shown by the effect of the residual effective alkali and residual sulphide in increasing brightness and decreasing permanganate number.

Although the re-cooking of the organic material in recycled black liquor does not appear to involve an appreciable consumption of cooking chemicals, the presence of the organic material in the cooking liquor does affect the pulping process. This was shown in the factorial experiment by the adverse effect of this material on the permanganate number and brightness.

The work done indicated that sulphate pulping process is affected by the components of the recycled black liquor and that the effect obtained is dependent upon the relative amounts of residual pulping chemicals and organic materials in this liquor. The effect of the recycled organic material does not appear to arise from a consumption of white liquor pulping chemicals.

Luncheon Program

Malcolm B. Pineo presided at the luncheon program which featured an address by Brig. Gen. Herbert D. Vogel, Chairman of the Board, Tennessee Valley Authority, Knoxville, Tenn. General Vogel discussed the growth that has taken place in the Tennessee Valley under the TVA program. To an increasing extent TVA has relinquished major responsibilities to states and local governments. Georgia has made outstanding progress toward achieving a full and modern forestry program. TVA's long range program is to provide a steady supply of pulpwood. Half of the Tennessee Valley is forested and 80% of the forest area is privately owned. It is the objective of the Authority to see the reforestation of 1.5 million acres of land. As of 1933 only about 4000 acres had been reforested. As of 1955, 35,000 Valley land owners have planted 280 million seedlings. TVA nurseries have produced about 340 million seedlings since 1934.

General Vogel was introduced by Karl O. Elderkin, vice-president and general manager of Bowaters Southern Paper Corp. The general was accompanied by A. J. Wagner, general manager of TVA, and Richard Kilbourne, director of TVA's forestry division.

Wednesday Afternoon Session

J. McK. Limerick, Bathurst Power & Paper Co., Bathurst, N. B., presided at the afternoon session in the absence of T. T. Collins, Hudson Pulp & Paper Co., Palatka, Fla., who was unable to be present.

The following papers were presented:

"The Foxboro Magnetic Flow Meter," by Harry S. Drinker, Jr., The Foxboro Co., Foxboro, Mass. Based on Faraday's law of induction, the new meter measures the flow of pulp stock and thick black liquor quite easily. Its calibration is independent of viscosity, density, turbulence, temperature, and pressure. The interpretation of Faraday's law is as follows: If a conductor is moved in a magnetic field, a voltage will be induced across it, proportional to its velocity.

"Thermal Conductivity of Sulphate Black Liquor," by R. L. Harvin and W. F. Brown, University of Florida, Gainesville, Fla. (presented by title).

Thermal conductivity studies of sulphate black liquor were

K. O. Elderkin, president of TAPPI

carried out at solids concentrations up to 53% at temperatures from 100 to 200°F. A special apparatus was designed for this purpose which incorporated downward heating the liquid sample in a layer 1/8-in. thick and approximately 6 in. in diameter. The heat also flowed through a similar parallel layer of water and the thermal conductivity of the sample was determined relative to water by measuring the temperature gradients across the two liquid layers. Equations were developed for use with the apparatus which showed the ratio of the thermal conductivity of the sample to that of the water to be inversely proportional to the ratio of the temperature gradients. Accurate values for the thermal conductivity of water were found summarized in the literature.

A linear correlation of thermal conductivity versus per cent solids with temperature as a parameter is presented. The data are also shown in the form of a line coordinate chart. No values of the thermal conductivity of black liquor are available in the literature for comparison. However, the values are consistent with what might be expected for aqueous solutions of the materials present in the black liquor.

"New Developments in Cleaning Recovery Boilers," by P. H. West, Thilmany Pulp & Paper Co., Kaukauna, Wis. In 9 months, operation at Thilmany, the Diamond shot-cleaning system, installed to clean the economizer, has proved to be superior to soot blowing in cleaning effectiveness, although there have been numerous operating problems. It is anticipated that the unsatisfactory electrification and excessive wear factors associated with the present installation can be eliminated by future changes and development; then the shot system should prove an efficient, economical, and trouble-free method of cleaning not only the economizer and air-heater, but possibly other portions of the recovery unit.

"Substitutes for Salt Cake and Sulphur in the Kraft Pulping Process," by A. W. Pesch, Southern Kraft Division, International Paper Co., Mobile, Ala. Salt cake is the standard and most important make-up chemical used in the kraft, or sulphate, process. The amount of salt cake available has been insufficient to satisfy the total requirements of the sulphate pulp industry. Modern mills, with low soda losses, frequently supplement the use of salt cake by adding elemental sulphur in order to maintain the required sulphidity. The reserves of elemental sulphur are limited and may, in the future, have to be supplemented with sulphur from other sources. The need for continued efforts to reduce soda and sulphur losses is stressed. Some important salt cake substitutes, and two possible substitutes for elemental sulphur, are listed. The theoretical evaluation of substitutes, based on the delivered prices of salt cake and/or sulphur, is discussed and illustrated by examples. Other factors affecting the actual practical value of substitute make-up chemicals are listed. The need for encouraging the adequate production of salt cake and elemental sulphur is indicated.

"Two-Stage Slaking—A Progress Report," by D. C. Gillespie and I. W. Johnson, Dorr-Oliver, Inc., Stamford, Conn. To determine the progress made since 1952 in two-stage slaking technique, a survey of seven mills now using this system was conducted in June of this year. Although systems varied between mills, two groupings could be made: those with reburned lime storage facilities and those without. Flow sheets of the lime handling and slaking system in three mills were presented as well as a description of each mill visited.

Two-stage slaking, in general, has (1) leveled out kiln surges and aided in control of causticity, (2) eliminated the need for additional green liquor heating, and (3) reduced the hot lime handling, the extent of the latter depending on the selection of lime storage facilities and by-pass arrangements.

The main problem with the operation of the system is grit removal from the primary slaker. Where layout permitted, gravity purging to the secondary was accomplished with little trouble. Continuous recirculation with intermittent purging was second best, with intermittent purging proving most troublesome due to line plugging around the pump. Best recommendation on grit removal is continuous pumping to point behind overflow baffle in primary. Stainless steel pump with semiopen impeller is best choice for this duty.

H. D. Vogel, chairman of the board, TVA addressing the Alkaline Pulping Conference

H. D. Vogel, TVA; K. O. Elderkin, Bowaters Southern Paper Co.; A. J. Wagner and Richard Kilbourne, TVA; and R. G. Macdonald, TAPPI

Hospitality Hour

The conference group were guests of Combustion Engineering, Inc., at a get-together party from 6:00 to 7:30 p.m.

Program of Thursday, October 20

Vernon Woodside, Olin-Mathieson Chemical Co., presided as moderator of the Thursday morning general session. The following papers were presented:

"Comparison of Sulphate Pulps from Mixed Tropical Woods with Industrial Kraft Pulps from Southern Hardwoods," by Karl Lauer, Department of Pulp and Paper Technology, University of Alabama, Tuscaloosa, Ala. Chemical and physical properties of sulphate pulps from mixtures of tropical hardwoods from the Brazilian Amazon were composed with those of industrially manufactured kraft pulps from mixtures of southern hardwoods and of hardwoods and pine. The behavior of the latter showed for the pulps investigated clearly the inferiority of mixed cooked hardwood-pine compared with pulps from the same hardwood mixtures alone. A comparison of the industrial pulps with tropical hardwood pulps showed compariable breaking-length and burst but lower tear and fold for the tropical pulps. Beating conditions have great influence on strength development and optimum strength characteristics.

"Deterioration of Straw-Piled Pulpwood," by T. L. Gilles and G. M. Ference, Brunswick Pulp & Paper Co., Brunswick, Ga. Pine, red oak, and gum were stored for definite periods of time. In general, the highest losses due to decay were experienced during the summer months. The speaker showed a table which indicated the number of months necessary to reach a given level of decay.

Bleachable grades of sulphate pulp produced from these woods show greatly reduced tearing strength as pulpwood decay proceeds. Burst and tensile strength are not adversely

affected. Pulp yield on a dry-wood basis decreases with increased decay. More alkali is required to cook decayed wood than fresh wood.

"Deterioration of Southern Pine Kraft in High Density Storage," by James E. Ayer, University of Alabama, Tuscaloosa, Ala. Three samples of pulp with varying levels of toxicant addition were retained at high density to determine the effect of microbiological organisms upon the pulp. The pulps were sampled over a two-week period and tested for physical changes and bacterial population. It was found that the strength of the pulp was not materially affected by retention but that the rate of slowness development was markedly increased, in all but the pulp with a 0.02% level of the toxicant addition. The toxicant employed was effective in retaining the physical properties of the pulp after retention if used above a certain minimum concentration.

"New Developments in Tall Oil," by Arthur Pollak, Tall Oil Association, New York, N. Y. Statistics were presented showing the trends in the tall oil industry. Among the products of refined tall oil are the surfactants, drying oils, tall oil rosin.

Luncheon Program

Karl O. Elderkin, of Bowaters Southern Paper Corp., presided as chairman of the luncheon meeting. Victor J. Sutton, mill manager at the Bowaters mill, welcomed the group and outlined some of the features of the Bowaters mill that would be seen during the Friday visit. These included a 2050 f.p.m. newsprint machine and the new grinder drive. 190,000 tons per year of newsprint are produced plus 60,000 tons of bleached and semibleached pulp for the market. New expansion is under way to provide for a new 276-in. newsprint machine producing three paper rolls. This expansion will be complete late in the fall of 1956. A new mill to produce hardboard and insulating board is under construction. The underwater storage system for logs is a novel feature of the mill. The sulphate pulp mill is conventional. The new digesters are stainless-clad. A 6000-hp. motor drives the new grinder which produces 55 to 65 tons per stone per day.

Semichemical Pulping Program

John N. McGovern, Parsons & Whittemore Co., New York, N. Y., presided as moderator of the Thursday afternoon session on semichemical pulping. The following papers were presented:

"Penetration and Diffusion in Wood. II. Comparison of Sodium and Ammonium Sulphites as shown by Burning," by J. E. Stone, Institute of Paper Chemistry, Appleton, Wis. Commercial cooking conditions produce a very complicated interaction between the many factors controlling penetration and diffusion of cooking liquors into wood. The temperature and pressure increase simultaneously and at the same time the moisture content and therefore the thermal conductivity of the wood increases continuously throughout the cook. Penetration and diffusion are two entirely different mechanisms of moving chemical through wood, and factors such as temperature, pressure, and wood moisture content influence each to very different extents. It is therefore extremely difficult to conduct "pure" diffusion or penetration experiments on idealized systems and thereby predict what will occur in a digester.

In order to avoid these difficulties of interpretation—which in the present case was the comparison of sodium and ammonium sulphites—similar wood specimens were cooked in each of the two liquors and the area of "burning" inside each specimen compared at the end of the cook. Each specimen was $1/2$ by $1/2$ in. in the two transverse directions, and $1/4$, $1/2$, 1, and 2 in. long in the fiber direction. Four different moisture conditions of the wood—viz., oven-dry, 43% moisture (oven-dry basis), 100% moisture (oven-dry basis), and water-saturated, were also studied, as well as two different times-to-temperature (16 and 90 minutes). The results were recorded photographically.

Little difference could be seen between either salt, regardless of the moisture content of the wood or time-to-temperature. Ninety minutes to temperature (170°C.) gave less "burning" than 16 minutes, as would be expected. The water-saturated wood showed less "burning" than the oven-dry wood, the maximum "burning" occurring with the intermediate moisture contents.

It is believed that this method could be used to advantage in comparing different woods, or sapwood and heartwood of a single species, or different concentrations and compositions of cooking liquors, or many other variables, and give results directly interpretable in terms of commercial practice.

"High Yield Sulphite Pulping-Poplar," by W. D. Kerr and S. A. Harding, Pulp and Paper Research Institute of Canada, Montreal, P. Q. Previous work at the Pulp and Paper Research Institute of Canada on the sulphite pulping of spruce had shown that large differences in yield could be obtained for small changes in acid composition. The work reported here was a similar study on the pulping of a commercial hardwood. Poplar chips were digested in solutions containing a fixed amount of sodium hydroxide to which were added varying amounts of sulphur dioxide. Cooking liquor composition was varied from strongly alkaline to strongly acidic and covered the neutral sulphite range completely.

The cooking was carried out at the miniature or 100-gram scale, in stainless steel bombs which rotated in an electrically heated glycol bath. A four-hour cycle was used in all cooks: 2 hr. from 115°C. to maximum temperature, followed by 2 hr. at maximum temperature. Maximum temperatures of 130, 140, 155, and 170°C. were chosen, with the 140° temperature investigated more extensively than the other levels.

At all cooking temperatures, the total yield reached a maximum with cooking liquors containing a mixture of sodium sulphite and sodium bisulphite, in the so-called buffered zone, from pH 9.3 to 4.5.

Evaluation of the results was facilitated by the use of the Ross diagram. This graphical representation pointed to advantages in carbohydrate-lignin ratios which it may be possible to obtain in the sulphite pulping of poplar. It was apparent from the diagram that the amount of carbohydrate retained for any particular delignification decreased as the temperature was raised.

The maximum sulphonation of the lignin, without solubilization, occurred with liquors of approximately 0.3 moles per liter SO_2 (pH 6.8) independent of the cooking temperature.

A second part of the project, to be carried out at the 2 cu. ft. scale, will begin shortly. Full chemical and physical tests, including strength evaluation will be carried out on all pulps, and a study of the bleaching characteristics of selected pulps will be also be performed.

"Determination of the Filtration Constant of Semichemical Pulps," by W. W. Marteny, and K. E. Olsen, National Container Corp., Tomahawk, Wis. A report on an apparatus designed and a test procedure developed which can be used as an indication of the degree of fiberizing of coarse pulp. The test is based on the determination of the specific filtration of the fibrous material.

"Kanzoki Continuous Pulp Mill," by R. G. Goodwin, Pandia Division, The Black-Clawson Co., New York, N. Y. A description of the new continuous semichemical pulping mill of the Kanzoki Paper Mfg. Co., Osaka, Japan. The mill operates on a mixture of hardwoods and is producing a bleachable grade of pulp for high grade papers. The new expansion was completed in March, 1955.

The papers presented at this conference will be published later in *Tappi*.

Program of Friday, October 21

About 280 persons visited the mill and properties of the Bowaters Southern Paper Corp. at Calhoun, Tenn.

PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Roger L. Barker, Technical Sales-Service Representative, American Cyanamid Co., Kalamazoo, Mich., a 1954 graduate of the University of Louisville.

Georg Bartheld, Chief, Works Laboratory, J. P. Bemberg A/G, Wuppertal-Oberbarmen, Germany, a graduate of the University of Freiburg with a Ph.D. degree.

David H. Bechtold, Salesman, Monsanto Chemical Co., Cleveland, Ohio, a 1950 graduate of the University of Illinois.

J. Edward Bender, Chief Engineer, Clermont Engineering Co., Philadelphia, Pa. Attended Drexel Institute of Technology.

Leonard P. Bundy, Electrical Supervisor, East Texas Pulp & Paper Co., Silsbee, Tex., a 1942 graduate of the University of British Columbia.

Cletus D. Coffman, General Superintendent, The Chesapeake Paperboard Co., Baltimore, Md.

William L. Conner, Sales Engineer, The Pusey & Jones Corp., Wilmington, Del. Attended the University of Pennsylvania and the Drexel Institute of Technology.

Arthur C. Cook, Application Engineer, General Electric Co., Cincinnati, Ohio, a 1940 graduate of the Massachusetts Institute of Technology.

George P. Cooper, Vice-President, Empire-Hanna Coal Div., The M. A. Hanna Co., Toronto, Ont., Canada.

John A. Dawson, Technical Supervisor, Canadian Boxes Ltd., Vancouver, B. C., Canada, a 1945 graduate of the University of British Columbia.

Virgilio Debin, Technical Director, Cartiere De Medici & Co., Milan, Italy, a 1936 graduate of the Politechnic College, Turin.

Richard C. Dempsey, Technical Sales Representative, A. E. Staley Mfg. Co., Decatur, Ill. Attended Cornell University.

Edward E. Den Dooven, Production Manager, Marathon Corp., Menasha, Wis. Attended the University of Wisconsin.

Richard W. Dornan, Technical Sales Representative, The Dow Chemical Co., Midland, Mich., a 1950 graduate of Kansas State College.

Winfield E. Drown, Sales Specialist, Monsanto Chemical Co., Seattle, Wash., a 1929 graduate of Northeastern University.

Arlo E. DuBois, Development Chemist, H. P. Smith Paper Co., Chicago, Ill., a 1949 graduate of Asbury College.

Howard J. Dyer, Branch Superintendent, Chase Bag Co., Toledo, Ohio.

John V. Eller, Technical Controller, H. P. Smith Paper Co., Chicago, Ill., a 1939 graduate of Ohio State College.

Thomas R. Elmblad, Chemical Engineer, Swenson Evaporator Co., New York, N. Y., a 1951 graduate of the University of Michigan.

Ernest G. Evans, Production Superintendent, Camp Mfg. Co., Inc., Franklin, Va. Attended William and Mary College.

Edgar H. Everton, Sales Manager, Neill, Cropper & Co. Ltd., Auckland, N. Z., a graduate of the University of New Zealand.

Robert W. Eyler, Chief Chemist, Hercules Powder Co., Hopewell, Va., a 1944 graduate of the University of Illinois with a Ph.D. degree.

Harold L. Fair, Technical Service Representative, Riordon Sales Corp. Ltd., New York, N. Y., a 1931 graduate of Marietta College.

James Flett, Chairman of the Board, James Flett Organization, Inc., Chicago, Ill.

George Forrest, Mechanical Engineer, Beloit Iron Works, Beloit, Wis., a 1934 graduate of Heriot-Watt College, Edinburgh, Scotland.

Peter A. French, Chemist, Great Northern Paper Co., Millinocket, Me., a 1955 graduate of Colby College.

Kazuo Fukuoka, Chief, Packaging Research Div., Industrial Art Institute, Tokyo, Japan, a graduate of Tokyo Higher Technological College.

John L. Galt, Director, A. F. Galt & Co. Ltd., Edinburgh, Scotland, a graduate of George Watson's College.

James S. Griffith, Jr., Technical Superintendent, O. B. Andrews Co., Chattanooga, Tenn., a 1949 graduate of Missouri School of Mines and Metallurgy.

Hector W. Griswold, Project Director, Chicopee Mfg. Corp., Chicopee Falls, Mass., a 1942 graduate of Princeton University.

Karl F. Halladin, Chemist, Waldorf Paper Products Co., St. Paul, Minn., a 1953 graduate of the University of Minnesota.

George L. Harman, Jr., Acting Manager, Bailey Meter Co., Cleveland, Ohio, a 1937 graduate of Rensselaer Polytechnic Institute.

Thomas G. Heiser, Director, Adhesive Research, Stein, Hall & Co., Inc., New York, N. Y., a 1929 graduate of Cooper Union.

James F. Hern, 2nd Lieutenant, Air Force, Chanute AFB, Ill., a 1954 graduate of New York State College of Forestry.

Charles H. Horch, Assistant to Manager, Wheelwright Div., The Mead Corp., Leominster, Mass., a 1942 graduate of Ohio State University.

William J. Hurrell, Assistant Plant Manager, Hinde & Dauch Paper Co. of Canada Ltd., Montreal, P. Q., Canada.

James E. Irvine, Chief Engineer, Condi Engineering Corp., Pittsfield, Mass., a 1937 graduate of the University of Manitoba.

William T. Johnson, Maintenance Superintendent, Albemarle Paper Mfg. Co., Richmond, Va., a 1950 graduate of Virginia Polytechnic Institute.

Herbert M. Kennedy, Instrument Supervisor, East Texas Pulp & Paper Co., Silsbee, Tex., a 1940 graduate of the University of Alabama.

Carl C. Landegger, General Director, Welser Papierfabrik, Wels, Austria, a 1951 graduate of Georgetown University.

James J. Larkin, Director of Quality Testing, Container Laboratories, Inc., Chicago, Ill. Attended Northwestern University and Loyola University.

William A. Leftwich, Technical Representative, Riordon Sales Corp., Inc., New York, N. Y., a 1950 graduate of Tulane University.

Harold G. Leighton, General Superintendent, Beckett Paper Co., Hamilton, Ohio, a 1934 graduate of Massachusetts Institute of Technology.

Edward T. Lingnowski, Quality Control Supervisor, French Paper Co., Niles, Mich.

Herbert M. Low, Vice-President and Manager of Power

Div., J. F. Pritchard & Co., a 1931 graduate of Kansas State College.

Adrian G. Magrath, Chemist, Plastic Coating Corp., Holyoke, Mass., a 1946 graduate of Dartmouth College.

Harold N. Malmberg, Assistant Plant Engineer, National Container Corp., Big Island, Va., a 1947 graduate of the University of Wisconsin.

Clifford Mayer, Assistant Chief Chemist, Publishers' Paper Co., Oregon City, Ore., a 1949 graduate of the University of Southern California.

Charles S. McGarry, Superintendent, Darby Paper Co., Inc., Lansdowne, Pa.

Edgar A. McGinnes, Jr., Research Chemist, Ketchikan Research Sec., American Viscose Corp., Marcus Hook, Pa., a 1955 graduate of Syracuse University.

Michael C. Milej, Technical Director, Milmont Fibreboards Co. Ltd., Montreal, P. Q., Canada, a 1947 graduate of the University of Leuven, Belgium.

Irving M. Millis, Paper Stock Buyer, Abbey Paper Stock Co., Philadelphia, Pa., a 1950 graduate of Temple University.

John L. Minnich, Sales Representative, Black-Clawson Co., Hamilton, Ohio, a 1949 graduate of Miami University.

Keiji Mizuno, Mill Manager, Nippon Pulp Industry Co., Nichiman Mill, Miyazaki-ken, Japan, a 1934 graduate of Technical College, Osaka University.

William H. Northup, Superintendent of Maintenance, St. Regis Paper Co., Pensacola, Fla., a 1942 graduate of Georgia School of Technology.

Edward Novick, Student, Lowell Technological Institute, Lowell, Mass.

G. Ruport Palmer, Jr., Production Executive, Burrows Paper Corp., Little Falls, N. Y.

Joseph J. Parks, II, Plant Engineer, Gardner Board & Carton Co., Lockland, Ohio, a 1943 graduate of Massachusetts Institute of Technology.

Alfred K. Plitt, Technical Sales-Service, Hercules Powder Co., Kalamazoo, Mich., a 1952 graduate of the University of Virginia.

Charles E. Price, Management Trainee, The Gardner Board & Carton Co., Middletown, Ohio, a 1950 graduate of West Texas State College.

William J. Proctor, Jr., Chief Chemist, Southern Clays, Inc., Gordon, Ga., a 1949 graduate of the University of Alabama.

Lester J. Randall, Chief Electrical Engineer, Walter Kidde Engineers-Southwest, Inc., Houston, Tex., a 1942 graduate of the University of Texas.

Leroy C. Rathsam, Sales Engineer, General Engineering Co., Jacksonville, Fla. Attended Butler University and Loyola University.

William E. Reinschmidt, Technical Salesman, American Cyanamid Co., Mobile, Ala., a 1947 graduate of Louisiana State University.

Albert E. Richter, Manager, Pulp and Paper Div., Hart Products Co. of Canada Ltd., Cuelph, Ont., Canada, a 1937 graduate of the University of New Brunswick.

Lantier H. Rolland, Assistant Manager, Rolland Paper Co. Ltd., Mont Rolland, P. Q., Canada, a 1942 graduate of the Paper Making School of Three Rivers.

James J. Ross. Executive Vice-President, Millspaugh (Canada) Ltd., Montreal, P. Q., Canada.

William E. Ross, Technical Assistant to the General Superintendent, Rome Kraft Co., Rome, Ga., a 1954 graduate of Mercer University.

Heinz Ch. Schilde, Director of Paper Mill, Papierfabrik Kabel A/G, Hagen, Westfalen, Germany, a 1928 graduate of the Technical University with a Ph.D. degree.

John Schornagel, Development Engineer, H. P. Smith Paper Co., Chicago, Ill., a 1948 graduate of Hope College.

Monroe F. Smith, Group Leader, Fibreboard Products, Inc., Research and Development Div., Antioch, Calif., a 1942 graduate of Washington State College.

Ralph W. Smith, Manager, Technical Service, Mississippi Lime Co. of Missouri, Ste. Genevieve, Mo., a 1941 graduate of Colorado School of Mines.

Charles C. Spencer, Technical Sales Representative, Reichhold Chemicals, Inc., Argo, Ill., a 1943 graduate of the University of Illinois.

Paul C. Spitler, Special Representative, F. X. Hooper Co., Inc., Glenarm, Md.

Henry E. Stevens, Research and Production Chemist, S. D. Warren Co., Central Paper Div., Muskegon, Mich., a 1950 graduate of the University of Michigan.

Charles L. Stewart, Superintendent, Keyes Fibre Co., Hammond, Ind., a 1932 graduate of the University of Maine.

Thomas D. Syme, Technical Supervisor, Crown Zellerbach Canada Ltd., Ocean Falls, B. C., Canada, a 1944 graduate of the University of British Columbia.

Oliver C. Tate, Machine Designer, John B. Kohler Co., Crystal Lake, Ill., a 1951 graduate of the Illinois Institute of Technology.

Kenneth G. Taylor, Civil Engineer, J. E. Sirrine Co., Greenville, S. C., a 1943 graduate of the University of Rhode Island.

Ralph E. Thompson, District Manager, Ansul Chemical Co., Philadelphia, Pa., a 1943 graduate of the University of Wisconsin.

Frank R. Valentine, Chemist, Homasote Co., Trenton, N. J., a 1937 graduate of Yale University with a Ph.D. degree in 1941.

William G. Vincent, Chemist, Strathmore Paper Co., West Springfield, Mass., a 1950 graduate of the University of Massachusetts.

Ray A. Wheatley, Fort William, Ont., Canada, a 1923 graduate of the Secondary Technical Institute.

Robert M. Whitman, Chemist, Millers Falls Paper Co., Millers Falls, Mass., a 1948 graduate of the College of William and Mary.

Harvey D. Woodbury, Purchasing Agent, Chaplin Corp., South Portland, Me., a 1936 graduate of Wentworth Institute.

Robert W. Wurst, District Sales Manager, Pennsylvania Salt Mfg. Co., Philadelphia, Pa. Attended Illinois Institute of Technology.

Charles A. Winn, Jr., Technical Assistant, Container Corp. of America, Philadelphia, Pa., a 1948 graduate of Georgia School of Technology.

TAPPI Notes

Henry J. Abernathy, formerly of the National Folding Box Co., is now General Superintendent of the Wallomsac Div., Columbia Box Board Mills, Inc., Chatham, N. Y.

Thomas Aitkin is now a chemical engineer for the Abitibi Power & Paper Co. Ltd., Sault Ste. Marie, Ont., Canada.

Clarence H. Anderson, Project Engineer for Chas. T. Main, Inc., has been transferred from Everett, Wash., to Boston, Mass.

Charles W. Atkinson is now Research Group Leader for the Caneo Plant, Pioneer Div., The Flintkote Co., Hilo, Hawaii.

Hans Baars, formerly of the F.A.O., is now a Consultant in Cape Town, Union of South Africa.

Nicholas Bachynski is now Branch Manager of the Reliance Electric & Engineering Co., Appleton, Wis.

John W. Bard is now Production Manager for the Pulp and Paper Mills of the Marathon Corp., Menasha, Wis.

Lewis W. Blight, Technical Representative of the Electrochemicals Dept., E. I. du Pont de Nemours & Co., Inc., has been transferred from Wilmington, Del., to Portland, Ore.

Gordon K. Bonham is now Project Engineer for the Scott Paper Co., Everett, Wash.

Edward F. Boyle, formerly of the Federal Paperboard Co.,

is now superintendent of the Board Mill of Waldorf Paper Products Co., St. Paul, Minn.

S. M. Bratton is now Vice-President of Pusey & Jones Corp., Wilmington, Del.

Robert E. Bringman, formerly of the St. Joe Paper Co., is now with the Riegel Paper Corp., New York, N. Y.

Sidney G. Briscoe is now General Sales Manager of Pusey & Jones Corp., Wilmington, Del.

R. William Brown, formerly of the St. Regis Paper Co., is now Chief Engineer of the Fitchburg Paper Co., Fitchburg, Mass.

C. Richard Calkins is now Director of Research for the Riegel Paper Corp., Milford, N. J.

David O. Chua, formerly of the University of Maine, is now a Graduate Student, Forest Chemistry Dept., New York State College of Forestry, Syracuse, N. Y.

C. Crispin is now Vice-President of MacMillan & Bloedel Ltd., Vancouver, B. C.

Alan K. Davidson, Quality Control Engineer for the Buckeye Cellulose Corp., has been transferred from Foley, Fla., to Memphis, Tenn.

H. A. DesMarais, formerly of the Geigy Chemical Co., is now with the Sales Development Dept. of Verona Dyestuffs Div., Verona Chemical Co., Union, N. J.

Fred B. Doherty, is now General Manager of Southeast Cellulose Manufacture for Rayonier, Inc., Jesup, Ga.

Robert J. Drexel, Jr., formerly of the Edgar Div., Minerals & Chemicals Corp. of America, is now a Project Chemist for Southern Clays, Inc., Gordon, Ga.

Aubrey N. Dunn, formerly of the Dunn Paper Co., is now a Manufacturers Representative, South Bend, Ind.

Newell W. Emery, Jr. of the Scott Paper Co. has been transferred from Everett, Wash., to Anacortes, Wash., as Technical Director.

Anthony L. Ensink, formerly of A. B. Dick Co., is now Technical Sales Representative for the Polychrome Corp., Chicago, Ill.

James E. Foote, General Manager of the Diamond Match Co., has been transferred from Plattsburg, N. Y., to New York City.

Hans W. Giertz, formerly of the Swedish Forest Products Laboratory, is now Acting Professor of Wood Chemistry at the Technical University of Norway, Trondheim, Norway.

William S. Grimes is now Assistant Manager of the Ahdawagan Paper Products Div., Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

Felix M. Hammack, Development Engineer for the Buckeye Cotton Oil Co., has been transferred from Memphis, Tenn., to Foley, Fla.

John T. Harrison is now Director of Corrugated Sales for the Union Bag & Paper Corp., Chicago, Ill.

Raymond G. Hart, formerly with the Borden Co., is now in the Quality Control Dept. of the Stevens Paper Mills, Inc., Westfield, Mass.

William C. Hayes is now Superintendent of the National Container Corp., Clyattville, Ga.

John T. Hegeman is now Assistant Manager of the Pulp Mill Div., Brown Co., Berlin, N. H.

Morris Huff, formerly of the Newark Paraffin and Parchment Paper Co., is now President and General Manager of the Wyndmoor Mfg. Co., Carteret, N. J.

Stanley B. Huss, formerly of E. W. Twitchell, Inc., is now in the Sales Service Dept. of F. C. Huyck & Sons, Rensselaer, N. Y.

Donald E. Johnson of the St. Regis Paper Co. has been transferred from Deferiet, N. Y., to Carthage, N. Y., Central Technical Dept.

Karl F. Landegger, President of Parsons & Whittemore Co., has been elected Chairman of the Board of the Black-Clawson Co., succeeding Homer D. Martindale who will continue as a member of the board.

James G. Lander, Service Engineer for the Diamond Alkali Co., has been transferred from Cincinnati, Ohio, to Painesville, Ohio.

Carl Magnus, formerly of Halltown Paper Board Co., is now a Consultant at 607 South Church St., Charles Town, W. Va.

James A. Mann, formerly of A. B. Dick Co., is now Chemist for Crocker, Burbank & Co., Fitchburg, Mass.

Thomas N. McLenaghen of the Abitibi Power & Paper Co. has been transferred from Fort William, Ont., to Iroquois Falls, Ont, as Assistant to the Mill Manager.

Richard W. Maley, formerly of the Central Paper Co., is now Assistant General Superintendent of the Chemical Paper Mfg. Co., Holyoke, Mass.

Ralph B. Millington is now General Plant Manager of the Wood Flong Corp., Hoosick Falls, N. Y.

William F. Mitchell, formerly of the Catalytic Construction Co., is now in the Chemical Div. of General Mills, Inc., Kankakee, Ill.

Fred Modern, formerly of the Bowaters Southern Paper Corp., is now Assistant General Superintendent of the St. Croix Paper Co., Woodland, Me.

Henry Z. Mohrer of the Research Dept. of the Federal Paperboard Co., Inc. has been transferred from Bogota, N. J., to New Haven, Conn.

Yim Ngan is now with Ets. Lieng Hoat & Cie Sarl, Phnom-Penk, Cambodia.

Teiwo Niemioja, formerly of the Sulphite Pulp Mfgrs. Research League, is now at the School of Public Health, University of Minnesota, Minneapolis, Minn.

Emil Padavic is now Technical Superintendent of the Container Corp. of America, Manayunk, Pa.

Vincent Pessolano, formerly of Ceprano o Atma's Paper Mills, is now with Adams S/A, San Giovanni Lupotota, Verona, Italy.

Clifford E. Peterson is now a Sales Engineer for the Riegel Paper Corp., New York, N. Y.

Sam H. Popovich is now Technical Director of W. C. Hamilton & Sons, Miquon, Pa.

C. A. Redden, formerly of Hollingsworth & Whitney Div., is now Staff Engineer of the Scott Paper Co., Chester, Pa.

Kenneth D. Reed, formerly of the DeLaval Separator Co., is now Manager of the Lubrication Section of the Dravo Corp., Pittsburgh, Pa.

Patrick J. Sullivan, formerly of the Marinette Paper Co., Div. of the Scott Paper Co., is now a Special Student at The Institute of Paper Chemistry, Appleton, Wis.

Leonard J. Timmer, formerly of Michigan Paper Co., Div. of W. C. Hamilton & Son, is now Supervisor of the Central Laboratory of Fort Wayne Corrugated Paper Co., Hartford City, Ind.

Claire Turner is now Sales Manager for the Appleton Woolen Mills, Appleton, Wis.

Hans Unander-Scharin, formerly of the Ruberoid Corp., is now Plant Engineer for A & P Corrugated Box Co., Lawrence, Mass.

Bruce Wally, formerly of the U. S. Army, is now Engineer for the Rust Engineering Co., Pittsburgh, Pa.

J. G. Weeldenburg is now Executive Vice-President of Algemene Kunstzerde Unie-N.V. Arnheim, Netherlands.

N. R. Yorke of the St. Regis Paper Co. has been transferred from Kalamazoo, Mich., to Trenton, N. J.

Richard J. Zeamer, formerly of the Nekoosa-Edwards Paper Co., is now Operating Engineer for the West Virginia Pulp & Paper Co., Luke, Md.

T. R. Segree is now Coordinator of Patents for the Central Research Dept., Crown Zellerbach Corp., Camas, Wash.

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Robert F. Stewart, Sales Manager of the Precipitator Div. has succeeded Richard F. O'Mara as the official representa-

tive of the Western Precipitation Co., Los Angeles, Calif., in TAPPI.

* * *

J. H. Nellmapius, Works Manager, has succeeded E. L. A. Folker as the corporate representative of Masonite (Africa) Ltd., Estcourt Natal, S. A., in the Technical Association.

B. B. Bhalla, General Manager, has succeeded O. P. Varma as the corporate representative of Shree Gospal Paper Mills Ltd., Jamma Nagar, Ambala, India.

John Wharton has succeeded R. Garnsey as the corporate representative of Courtaulds (Alabama), Inc., Mobile, Ala.

Industry Notes

Production

Paper and board production during August amounted to 2,605,927 tons, according to the Bureau of the Census, Department of Commerce. This was 14% above the 2,292,810 tons produced in August a year ago. Paper production amounted to 1,078,842 tons, which was 9% above the 991,082 tons produced in August a year ago. The output of paperboard during this month was 1,217,994 tons reflecting an increase of 18% over the production of 1,033,283 tons reported during August, 1954.

Wood Pulp

Wood pulp production continued at a high rate during July and for the January–July period was 11,900,000 tons, a 10% increase above production for the comparable period last year.

With paper and board production continuing at a record rate during the summer, wood pulp consumption stayed at a high level. For the first 7 months of this year consumption was 12,223,000 tons, an increase of 12% over consumption for the comparative 1954 period.

Total imports of wood pulp for the first 7 months increased moderately, though imports from Europe were still below last year. Imports from Canada increased from 937,057 tons to 1,026,167 tons, while imports from overseas declined from 218,457 tons to 197,590 tons.

Wood pulp exports have averaged about 53,000 tons monthly for the January–July period this year as against a monthly average of 30,000 tons in 1954.

Pulpwood

Pulpwood receipts for 1955 through July were 18,217,000 cords, an increase of 2,498,000 cords above receipts for the comparable months last year. Domestic receipts increased 2,369,000 cords and imports 498,000 cords.

Consumption of pulpwood in the January–July period totaled 19,094,000 cords an increase of 2,474,000 cords. Regionally, the Northeast area reported 13.4% of the total consumption, the North Central, 10.1%, the South Atlantic 33.5%, the South Central 23.5% and the West 19.5%.

Wastepaper

Receipts of waste paper for the first 7 months this year totaled 5,063,000 tons, a 10% increase over receipts for the comparable months in 1954.

Consumption of waste paper in July was 627,000 tons raising consumption for the January–July period this year to 5,087,000 tons, a 10% increase over the same period in 1954.

At the end of July inventories were 434,000 tons, a decline of 20,000 tons below June and 32,000 tons below July of last year.

Newsprint

Production and shipments of newsprint in North America during September, 1955, amounted to 628,180 tons—an all-time September peak—and to 625,812 tons, respectively, compared with corresponding totals of 590,459 tons and 583,475 tons in the same month of last year. Output in the United States was 124,966 tons—the largest September volume since 1926—and shipments were 124,257 tons while Canadian (including Newfoundland) production amounted to the all-time September high of 503,214 tons and shipments to 501,555 tons.

Through the end of September this year United States mills turned out 243,031 tons or 27.7% more newsprint than in the first 9 months of 1954 while output in Canada also was 154,135 tons or 3.5% greater than in the corresponding period of last year, thus the continental increase totaled 397,166 tons or 7.5%.

Following announcements in October by three Canadian companies, St. Lawrence Corp., Abitibi Power & Paper Co., and Canadian International Paper Co., that the price of newsprint would be increased, the U. S. Justice Dept. invited United States newsprint producers to confer with officials of the department with a view to preventing any joint effort to increase newsprint prices. The Canadian increase also prompted requests that the Administration and Congress look into the possiblity of increasing U. S. production of newsprint from Alaskan pulpwood and from bagasse.

U. S. Imports

In the past, attention has been directed here to the growing interest of the pulp and paper industry in developing foreign markets. However, whereas exports by this industry, despite their encouraging growth in recent years, constitute a minor part of this country's total exports, imports, consisting chiefly of pulpwood, wood pulp, and newsprint, have consistently represented a major proportion of total United States imports and have been an important source of the dollar exhange necessary for financing the export trade conducted by United States industries.

Although the United States imports the raw materials for, and finished products of this industry from numerous countries around the world, such purchases are made chiefly from Canada, Finland, and Sweden in the order listed. In 1954 imports from these three countries comprised 97% of the total dollar value of such purchases.

Canada has long been the principal foreign beneficiary in several ways. The importance of United States purchases to the Canadian producers of wood pulp is underscored by the fact that during 1954 the 1.7 million tons obtained from them was equal to 17% of their total output and 77% of the amount exported. With regard to newsprint, the statistical data available show the growth of the industry in Canada and the increase in United States imports have been parallel. Between 1939 and 1954 the production of newsprint in Canada increased by 2.8 million tons. Over the same period United States imports of that grade rose by almost 2.7 million tons. It is clear that the newsprint industry in Canada has grown almost entirely on the basis of demand generated in this country.

More basic, perhaps—and to the benefit of both countries—is the fact that the ability of Canadian sellers of pulpwood and manufacturers of pulp and paper to earn dollars in this country has played, and will undoubtedly continue to play, so vital a role in financing the trade between Canada and the United States. In 1954, by way of illustration, the foreign value of United States imports of paper and paper materials from Canada amounted to 839 million dollars, equal to 29% of the almost 2.8 billion dollars represented by Canadian purchases in the United States.

The volume of imports of pulp and paper from Finland and Sweden is small compared with that from Canada. Nevertheless, the dollars made available by such imports constitute a significant proportion of the dollar value of our exports to those countries. In 1954 imports of pulp and paper from Finland, at 33 million dollars, were equal to 85% of the value of

total imports from that country and were, in fact, 5 million dollars more than the total value of United States exports to Finland. Thus, in addition to providing the full amount of dollar exchange required to finance United States sales to Finland, an additional 5 million dollars were made available for other uses. Although imports of pulp from Sweden—their principal item of trade—have been diminishing, the dollar value continues to be substantial and in 1954 amounted to 29 million dollars, equal to 38% of the total value of United States imports from that country, and 24% of the total value of United States exports to Sweden.

Holland

To ensure timber supplies for future paper production, the Dutch firm, Van Gelder Zonen, has recently signed an agreement with the Surinam Government. The company will invest 1 million Dutch guilders (U. S. $261,100) in trial plantation of tropical coniferous trees on about 10,000 acres of prairie land. The whole project is of a long-term nature, since it will take 25 years before actual returns can be expected.

South America

Paper and products exports to Latin American Republics for the first half of this year totaled $37,700,000, an increase of $7,100,000 above exports for the first half of 1954.

Mexico

Mexico, within a little more than a year, will change from a nation chronically experiencing newsprint shortages into a newsprint exporter.

This turnabout is being achieved through installation of two paper mills with federal funds and participation of United States capital provided by the Bank of America.

Newsprint production from new plants is expected to reach 100,000 tons in 1957. This would cover internal needs of 80,000 tons and allow for a surplus of 20,000 tons, to be exported to Central American areas.

Mexico's drive for newsprint production may take on even greater impetus, for it is known that Nacional Financiera is studying possibilities of establishing newsprint plants in Tabasco and Chiapas and, perhaps, other sections of the Republic.

Raul Sandoval, of the Papaloapan Commission, has revealed that pine pulp will be used for production of 33,000 tons of newsprint annually at the Tuxtepec plant.

The Uruapan newsprint plant will cost an approximately equal amount, representing an over-all investment of around $25 million for the two.

Nacional Financiera is already taking aerial maps of terrain in both areas, charting forest areas, centers of population, communications facilities (roads, rivers), river currents, etc., as a basis for scientific exploitation of both areas. Plans will be the most extensive ever undertaken in Mexico, including a division of forest areas into "quality zones" according to age of trees, density, and botanic composition.

If expansion plans materialize, and other mills are established, then, coupled with present facilities, Mexico's exportable surpluses of newsprint, it is suggested, may jump to more than 100,000 tons within the next 5 years.

Norway

Aktieselskapet Borregaard, Sarpsborg, Norway, is building a plant to burn the spent liquor from its 500-ton calcium-base sulphite mill, using the Zimmerman process, controlled by Sterling Drug Co., New York, N. Y. The $3,000,000 plant is expected to produce 220,000 lb. per hour of steam at less than 50¢ per 1000 lb.

Borregaard will act as exclusive agent for Sterling in Europe for the licensing of the process. Sterling Drug will license the process in other countries and is also prepared to design and supervise construction of the necessary plant facilities. The process was invented by Frederick J. Zimmerman of Sterling and tested at Salvo Chemical Corp., Wausau, Wis., a Sterling subsidiary.

Further technical details of the process were published in the June, 1955, issue of *Tappi*, page 165 A.

India

India is studying the feasibility of using bagasse to produce pulp for newsprint and printing papers.

Chile

The Chilean newsprint industry is growing in importance. Surveys indicate that forest resources can furnish raw material ten times larger than domestic demand and the industry in time will have an important export potential. Domestic consumption of newsprint is estimated at 25,000 tons a year, of which practically 50% is imported. Those familiar with the trade express the opinion that by 1960, Chile may be more than self-sufficient in newsprint and paper production.

Hardwood Utilization

In all sections of the country there is a trend toward increasing use of hardwood for pulp.

Each year more plants are installing facilities for utilizing hardwoods in the pulping processes. Some companies are building plants to use only hardwoods. Research is under way in industry, university, federal, state, and private laboratories for greater utilization of the hardwood species.

For the country as a whole, hardwood pulpwood consumption in 1953 increased 15.2% over 1952. Sectionally, the increases in 1953 over 1952 were as follows:

Northeast	5.7%
North Central	16.1%
South Atlantic	11.1%
South Central	27.3%
West	17.4%

In the 12 southern states, increases in recent years are as follows:

1952—up 17% over 1951
1953—up 13.4% over 1952
1954—up 11.0% over 1953

More D.C. Drives

The industrial trend toward greater mechanization and more automatic means of production is sharpening demand for direct-current purchases of d.c. motors in the 1 to 200 hp. range are up 85% since the end of World War II. This compares with a 20% increase in the same period in purchases of all motors within that power range.

Forestry Publications

The Northeastern Forest Experiment Station, Upper Darby, Pa., has issued *Forest Statistics Series*, Pennsylvania No. 1, "Forest Statistics for the Anthracite Section of Pennsylvania," and *Beech Utilization Series* No. 13, "Silvicultural Characteristics of American Beech," *Forest Resource Report* No. 9, "Tennessee's Timber Economy," is available from the Superintendent of Documents, Washington, D. C., at 55 cents per copy.

Pulping Effluent Study

The first year of cooperative study on the Roanoke River in respect to rock fish spawning is nearing completion. The North Carolina Stream Sanitation Committee, The Wildlife Resources Commission, resident mills, and the National Council carried on coordinated surveys to determine what effects water quality changes brought about by upstream power dams and mill effluents had on rock fish spawning. The investigations were carried out by Herbert F. Berger, resident

engineer of the National Council, Willis M. Van Horn, of the Institute of Paper Chemistry, and B. B. Brandt, of North Carolina State College.

Information obtained to date did not indicate that pulping effluents have any deleterious effect on the rock fish spawn. Indications are that spawning is widespread along the river and not limited to a small area as previously thought.

Semichemical Recovery

Two companies have announced plans to install spent evaporation, burning and chemical recovery plants for existing neutral sulphite semichemical pulp mills; the Mead Corp. for their Lynchburg, Va. mill, and National Container Corp. for the Big Island, Va., mill. These installations should improve water quality in the James River to a considerable degree.

The Watervliet Paper Co., at Watervliet, Mich., is installing a similar recovery system in connection with expanded semichemical pulping operations. This plant was motivated largely by the requirements of the Michigan Water Resources Commission, with respect to discharge into the small stream upon which the mill is located.

New Mills and Facilities

Listed below are new mills or facilities that were announced, planned, under construction, or completed in the U. S. during the last 6 months of 1954 and the first 6 months of 1955:

Firm	*Product*	*Dollars*	*Job Status & Remarks*
American Box Board, Filer City, Mich.	Semichemical pulp	12,000,000	In production late 1954, 350 tons per day. Largest of type in U. S.
Bowaters Southern Paper, Calhoun, Tenn.	Newsprint, kraft pulp	60,000,000	In full operation late summer 1954. Already expanding from 160,000 tons per year newsprint and 65 tons per year kraft pulp to 275,000 tons per year newsprint. $25 million expansion due complete fall 1956
Buckeye Cellulose, Foley, Fla.	Pulp	25,000,000	In operation summer 1954. 300 tons per day
Coos Bay Pulp, Anacortes, Wash.	Sulphite pulp	1,000,000	Expansion underway
Crossett, Crossett, Ark.	Bleached food container board, related products	16,000,000	150 tons per day. To operate end 1955
Crown Zellerbach, Antioch, Calif.	Unbleached kraft paper	.....	400 tons per day unit to operate mid-1956
Crown Zellerbach, St. Helens, Ore.	Bleached kraft pulp and paper	14,000,000	35,000 tons per year. General expansion underway
East Texas Pulp & Paper, Evadale, Tex.	Bleached pulp kraft paper	27,500,000	300 tons per day of both products. Started operation Dec., 1954
Great Northern Paper, East Millinocket, Me.	Newsprint	.....	Increased capacity by 500 tons per day late 1954
Hudson Pulp & Paper, Palatka, Fla.	Bleached sulphate pulp, bleached kraft paper, tissue	15,000,000	Expansion to be complete early 1956
International Paper, Mobile, Ala.	Newsprint	20,000,000	Under construction. 100,000 tons per year. Due complete end 1956. Expansion
National Gypsum, Westwego, La.	Paper	6,000,000	Planned
R. W. Paper, Longview, Wash.	Glassine and greaseproof paper	7,000,000	Under construction. New company formed by Rhinelander and Weyerhaeuser
Rayonier, Southeast	Pulp	30,000,000	New 100,000-ton pulp mill announced
Riegel-Carolina, Acme, N. C.	Pulp	5,800,000	To expand 33%
St. Mary's Kraft, St. Mary's, Ga.	Bleached paper	.....	Operating early 1955. Unusual design more flexible process
Scott Paper, Anacortes, Wash.	Pulp	1,000,000	Major improvement program completed July 1955
Scott Paper, Detroit, Mich.	Paper	.....	New paper machine and converting equipment due to operate before end 1955
Southland Paper Mills, Lufkin, Tex.	Newsprint	.....	Expansion completed summer 1954. Capacity increased by 70,000 tons to 200,000 tons per year
United States Gypsum, New Orleans, La.	Paper	Multimillion	Planned
United States Gypsum, Houston, Tex.	Paper	5,000,000	Under construction
Valentine Pulp & Paper, Bayou Lafourche, La.	Paper	.....	Increasing production from 50 to 75 tons per day. From bagasse
West Virginia Pulp & Paper, Pennsylvania	Pulp	30,000,000	Planned. Part of $100 million for new plants and equipment during next 5 years
Western Kraft, Albany, Ore.	Kraft paper	.....	Due on stream November 1955. 100 tons per day
Weyerhaeuser Timber, Cosmopolis, Wash.	Pulp	20,000,000	Construction to start late this year. Complete 1957

—from *Chemical Engineering* 62, No. 13 (Mid-October, 1955).

Artificial Lightning to Kill Trees

"Shock polarization" is being used to destroy unwanted hardwoods in an experiment being conducted by Lawrence C. Walker at the University of Georgia's school of forestry in Athens. Electricity from a mobile generator provides an artificial "lightning strike" which kills the tree it hits. Mr. Walker is conducting the tests to collect data on best methods for killing unmerchantable hardwood trees.

New Chemicals and Materials

The following notes concern new chemicals and materials or new uses for materials of interest to the pulp and paper industry:

Lignin

In chemical wood pulping tremendous quantities of lignin are unavoidably produced as by-product and are usually dumped into the nearest stream or burned for fuel. But three developments are causing the paper industry to regard lignin with new interest; stream pollution problems, insight into lignin's inner working, growing industrial emphasis on squeezing raw materials dry of dividends, and throwing nothing away. Lignin now costs 6 to 8¢ a lb. Mass produced it could easily sell for less than a nickel. This price plus a potential supply of 10 million tons per year makes it attractive to the pulp and paper industry. Three roads for lignin utilization are: use of whole lignin, its salts and lignosulpho-

New Processes and Technology

New products and processes developed recently in the pulp and paper industry are tabulated below:

Product	*Process*	*User*	*Features*	*Status & Remarks*
Hardwood pulp	Chemigroundwood	Great Northern Paper Co., East Mallinocket, Me.	Process developed by N. Y. State College of Forestry cooks 4 ft. hardwood logs in neutral sulphite liquor in 62 × 10½-ft. digester, after initial evacuation. Logs are then reduced to fiber by grinding on special dull stones. 85–90% yield with big saving in cooking time, power for grinding	350 tons per day chemigroundwood capacity enabled company to use up to 30% hardwood pulp in newsprint, tripling newsprint capacity in $45 million expansion
Kraft mill odor elimination	Trapping and chlorination	Weyerhaeuser Timber Co., Everett, Wash.	Vaporsphere system consists of a 25-ft. diam. steel sphere covering a leakproof plastic diaphragm. Sulphur gases released from digester are trapped here, then drawn off slowly and mixed with chlorine	New installation has cut by 90% objectionable odors remaining after off-gases are condensed
Kraft mill waste disposal	Bio-oxidation	West Virginia Pulp & Paper Co., Covington, Va.	First activated sludge plant to treat pulp mill wastes reduces B.O.D. of 16–24 million gal./day from 140 to 15 p.p.m. Only nutrients needed for activated sludge organisms are 2 p.p.m. phosphorus as H_3PO_4 and 4 p.p.m. nitrogen as NH_2	Process involves primary settling, addition of nutrients, aeration of waste and activated sludge, sedimentation, clear overflow recycle if settled sludge organisms
Kraft pulp	Continuous cooking	.....	Kamyr continuous cooking process is claimed capable of producing a pulp equal to that made by batch systems	Developed by A. H. Lundberg, Inc. A 30–60-ton-per-day unit is in operation
Newsprint	Semichemical pulping	.....	Allows use of 40% poplar wood in newsprint compared to 20% previously used successfully	Process developed by Kinsey Chemical Co.
Nitrate pulp	Nitric-acid digestion	. .	New French Delbay process claimed to pulp any kind of cellulose in 3–4 hr. with 30 Bé. HNO_3 at room temperature and pressure. Neutralization and bleaching follow digestion. Claim 50% pulp yield for most raw materials, HNO_3 selectivity attacks lignin with little effect on cellulose	20-ton demonstration plant being built in France. Expect investment to be $35,000 per daily ton. Process offered in U. S. by Council on Public Relations, New York
Paper, coated	Electrostatic	Bergstrom Paper Co., Neenah, Wis.	Coating material is charged electrically and developed on paper web with strong electrostatic fields	Developed by Battelle Memorial Institute, Columbus, Ohio
Paper stock, cleaned	Vacuum-deaerator cleaning	Numerous	In Deculator-Cleaner process, dilute paper stock is sprayed into vacuum receiver, then goes into centrifugal separator. Process removes both air and dirt from stock	Developed by Rotareaed Corp., in cooperation with Bauer Bros. Co., Springfield, Ohio
Pulpwood	Chemical debarking	Various	Live trees are debarked by use of sodium arsenite	17 firms have purchased process for public use
Sulphite pulp	Continuous	American Box Board Co., Filer City, Mich.	Completely continuous process makes pulp from hardwoods. Includes new continuous digester, refiner, and screw press for washing	Designed by American Box Board and Sumner S. Sollitt Co. A 13-ton per hour plant is in oper-
Sulphite pulp	Quick cook	United Paper Mills, Ltd., Valkeakoski, Finland	Cooking time is cut 30% without loss in quality	Commercially proved. Conversion of several other mills underway
Sulphite pulp	Soda-base digestion	Nekoosa-Edwards Paper Co., Port Edwards, Wis.	Process substitutes caustic soda for limestone in making sulphite cooking liquor. This is expected to make cooking liquor recoverable and so cure pollution problem	Developed by Western Precipitation Co.

—from *Chemical Engineering* 62, No. 13 (Mid-October, 1955).

nates as they are recovered from pulp liquors without further processing except purifications; unit processing of lignin to produce useful derivatives; controlled, systematic breakdown of whole lignin into lower molecular weight organic materials. Lignin's industrial uses cover a wide variety of things including: rubber reinforcement, asphalt emulsion stabilization, ceramic binders and deflocculants, dry levelers and dispersants for dyeing of cotton and regenerated cellulosic textiles, oil drilling mud additives, protein precipitation, plastic extenders. Sodium lignate may be used in place of lignin where water solubility is an advantage. Lignosulphonates can be used in conversion to vanillin, as dispersing agents in concrete, pigment mixes, carbon black rubber masterbatches. Lignin degradations are known experimentally: oxidation yields benzene derivatives; hydrogenation gives cyclohexane derivatives; other reactions yield a variety of phenols, acids, alcohols, hydrocarbons. Many of these chemicals are obtainable from coal in which case lignin would be hard pressed as a competitive source. But some of them are much more unique. Most lignin degradations performed in structural studies have been pretty drastic, resulting in fragmentary products of relatively low molecular weights and based on a single benzene ring. The inevitable question: Can a carefully controlled, milder degradation split lignin into fairly large pieces and thus give rise to a new series of chemicals having intermediate molecular weight? No wonder paper men are giving lignin a close hard look. This old "nuisance," which is so abundant and so cheap, may be their no. 2 asset.

Size, Paper

Mersize RM Dry combines optimum fortification with highest efficiency in sizing papers. Sharp reductions possible in amount of size needed compared with rosin size. RM Dry may be added directly to beater in dry form or as water solution—Monsanto Chemical Co., St. Louis 4, Mo.

Sizing Agent

Aquapel reacts with cellulose paper fibers to form strong chemical bonds that yield hard, permanent sizing and resistance to water penetration. Size requires no alum, can be applied under acid or alkaline conditions. Properties of Aquapel-sized paper and some suggested end uses include hard sizing (dairy product containers and drinking cup stock), sizing at high pH (papers requiring permanence, noncorrosive papers, alkaline filled and coated papers), alkali resistance (soap wrap, reproduction paper, paper or board for use with silicate adhesives), improved strength (bag paper and boxboard)—Hercules Powder Co., Wilmington 99, Del.

Synthetic Fiber Paper

Dacron, nylon, and Orlon papers—made experimentally for the first time—have chemical resistance; high strength; resistance to molds, bacteria, light. Synthetic fiber papers are stronger, have 200 times greater resistance to folding than paper from pulp or rags. Manufacture is similar to conventional papermaking. Manufacturer thinks new paper can be made commercially, is making experimental details available to the paper industry—E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.

Waste, Semichemical Pulp

Commercial outlet for semichemical pulp waste liquor is in road treatment. Advantage over other materials: waste is chemically neutral. It lays dust and binds road material together to form a more compact, stable roadbed. Binding action slows drift of loose material toward roadside, should lower future graveling costs—Otsego Falls Paper Mills, Otsego, Mich.

—from *Chemical Engineering* 62, No. 13 (Mid-October, 1955).

New Insulated Container

The Air Material Command has developed a water-saturated container to keep foods from freezing. A sealed inner container wrapped in a vapor barrier is enveloped in a 1-in. layer of absorbent material saturated with water. After wrapping with another vapor barrier the package is placed in another container and sealed.

Under these conditions, water takes about 6 hours to freeze in an atmosphere of −65°F., so the temperature inside the package cannot fall below 32°F. for this length of time.

Waste Treatment Publication

"The Principles of Industrial Waste Treatment," is the title of a new book by C. F. Gurnham, published by John Wiley & Sons, Inc.

Bolton Awards

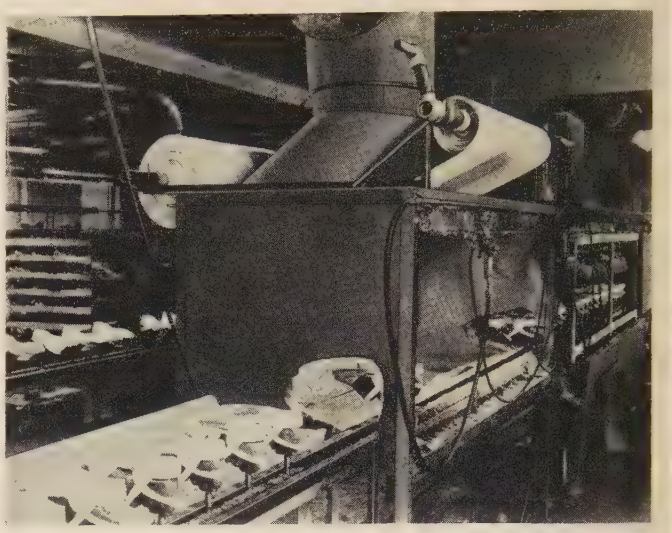
The awards for the Eighth Annual Essay Contest, sponsored by John W. Bolton & Sons, Lawrence, Mass., were announced recently. Donald G. Estabo, Mead Corp., Leominster, Mass., won the first prize of $1000; Wilfrid Gallay, E. B. Eddy Co., Hull, Que., won the second prize of $750; and Vera M. Berney, Crown Zellerbach Corp., Camas, Wash., won the third prize of $500.

Mail Order Catalogs

Montgomery Ward & Co. uses 1400 carloads of paper and spends $20 million annually for the services and products of the graphic arts industry in producing the 75,000,000 catalogs it distributes.

Paper Screens

The Bee and Bee Shoe Co., Manchester, N. H., is using Saxolin paper woven mesh to replace wire screen in its latex



In the spraying booths of Bee & Bee Shoe Co., open-mesh Saxolin yardage has replaced a wire screen used to catch surplus latex threads. A two-roll mechanism was devised providing a continuous clean square of Saxolin ceiling. On complete saturation of ceiling the Saxolin is merely rolled onto a disposable take-up roll. The idea, developed by a member of the shoe firm in cooperation with Chase Bag Co., Chicago, completely eliminated cleaning of wire screen and reduced fan blade cleaning to a weekly rather than daily chore

spraying booths. The Saxolin, produced by Chase Bag Co., is replaced at will by cranking the used portion onto a take-up roll.

Papermaking

Until Nicolas Robert, a papermaker in the mill of Didot, at Essonnes, France, invented a papermaking machine, in 1798, all paper was made by hand—a slow, tedious process. Henry and Sealy Fourdrinier bought Robert's patent. They commissioned an engineer, by the name of Donkin, to build an improved papermaking machine after Robert's idea and patent. By 1803 the first practical paper machine was in operation. This fourdrinier was basically the pioneer of today's huge papermaking machines that now make a sheet of paper up to 302 in. wide.

The fourdrinier principle flowed the wet pulp on to a continuous wire screen which carried the wet pulp forward, draining water as it went, to a cylinder revolving an endless felt web—thence to more cylinders which pressed the paper further, then to be cut into sheets from moist rolls and hung in a drying loft. Later drying cylinders were invented by Thomas Crompton and improved by Robert Ranson about 1839.

About 1809, John Dickinson, who contributed greatly to the budding paper industry, invented a cylinder papermaking machine which differed from the fourdrinier in having a cylinder, covered with a fine woven wire screen, which picked up pulp by revolving in a vat and then forced the pulp fibers into a wet sheet of paper, on the revolving screen, by suction. The sheet then was carried to another cylinder, covered with felt, to squeeze the paper and thence to the drying room. Among Dickinson's other inventions in 1824 was a machine for pasting sheets forming cardboard.

The first papermaking machine installed and operated in the United States was a cylinder type, after Dickinson's idea, in the mill of Thomas Gilpin near Philadelphia in 1817. Among those Americans who secured patents on a cylinder machine were Joshua Gilpin, Charles Kinsey of New Jersey,

and John Ames of Massachusetts. By 1830, many mills here were equipped with cylinder machines.

The first fourdrinier built by Donkin, imported in this country, was in 1827, and erected by Beach, Hommecker & Kearney, in Saugerties, N.Y. This machine made paper with a width of 60 in.

South Windham, Conn., was the locale of the first fourdrinier built in the United States, in 1829 by Smith & Winchester. It was installed in Norwich, Conn., for the Hubbard mill.

Until 1847, wire screen for fourdriniers was imported entirely from England. An expert English wire maker, named Stainar, came to America and became a partner of Stephens & Thomas in Belleville, N. J. With Van Houten, Stainar wove the first paper machine wire in this country. Felts were also imported from England up to 1864. Then the small firm of Johnson, Fuller Co. of Camden, Me., which later became absorbed by the Knox Woolen Co., made the first felts for paper machines in America.

Pulps, for papermaking, other than rags were given attention by papermakers. Hugh Burgess, an Englishman, stands out in paper history as the inventor of the chemical wood process in 1852, for making better white book and writing papers, using caustic soda to separate the fibers. Two years later, Burgess came to the United States with his soda pulp process and secured a patent here. Refinements in the process were made during the next 10 years and by 1866 soda pulp was made on a commercial basis by the American Wood Pulp Co. of Philadelphia.

About the time Burgess came to America in 1854, another important development took place in papermaking the invention of a machine that ground wood into a fine consistency. In 1855, Keller, a German, observed wasp nest-making, as did de Reaumer, 140 years before. Wasps chewed vegetable fibers which were mixed with liquid substance creating a paperlike nest. This gave Keller an idea and with an engineer named Voelter, he developed the groundwood pulp process. A few years later the machine was patented in France, England, and America by Voelter.

The first Voelter pulp grinders in America were set up in a mill in Curtisville, Mass., by the Pagenstecher brothers who delivered the first groundwood pulp, made in this country, to the Smith Paper Co. of Lee, Mass., in 1867. This shipment was used to make newsprint. The results were excellent and before long other mills used groundwood pulp. The Pagenstechers built the machines, under patent, and sold them to several mills in Maine, Massachusetts, and Connecticut. After the Voelter patents ran out in 1884, other companies built the machines. Newspapers and periodicals are the chief consumers of paper made from groundwood pulp.

About 1865 another chemical pulp making process was invented by G. B. Tilghman, of Philadelphia. This was called the sulphite pulp process. Tilghman and his brother had experimented with this process in France about 8 years before. However, it remained for Fry and Ekman, of Sweden, to perfect the sulphite process about 1871. This process was first used commercially in the United States, about 1882, by C. S. Wheelwright, in Providence, R. I. A German chemist, Alexander Mitscherlich, also contributed to the development of the sulphite process, as did Partington of England, and Kellner and Ritter of Austria.

The last of the chief pulp making processes, in use today, to be invented, was sulphate or kraft pulp. It was brought out in Danzig, Germany, about 1879, by Dahl. By 1886 Europe had many sulphate mills. Brompton built the first sulphate paper mill in North America in Quebec province of Canada in 1907. The first sulphate mill in the United States was established at Muskegon, Mich., by the Central Paper Co. in 1908, although the first sulphate pulp mill operated commercially was in 1909 at Roanoke Rapids, N. C., by the Roanoke Rapids Paper Mfg. Co.

The fibers in sulphate pulp are very strong and are used for wrapping papers, bags, kraft board, towels, shipping containers, etc. Today, paper products made from sulphate pulp, absorb the greatest tonnage. Because of the abundant supply of faster growing southern pine, the largest kraft paper products mills are located in the southern United States. Hundreds of paper mills span this country today, north, south, east, and west, employing many thousands of men and women. In 1953 the total tonnage of all paper and paper products made in the United States exceeded 26,566,000 tons —or about 391 pounds consumption per capita—quite a difference from the total output of 4,000 tons annually in the early 19th century.

—from *Forest Echoes*, August, 1955.

Consolidated

Biron Division of Consolidated Water Power & Paper Co. will be the site of Consolidated's multimillion dollar expansion program. Construction of facilities there to accommodate a new, high-speed enamel paper machine will begin as soon as possible with the unit scheduled for full operation by June 1, 1957. It will have a speed of from 2000 to 2500 f.p.m. and a width of 185 in., and will increase the company's enamel paper production by 30%. It is estimated that the entire expansion program will cost $15,000,000.

Additional sulphite and semichemical pulp will be supplied to Biron from existing facilities at Wisconsin Rapids Division through the pipeline connecting the plants. Wisconsin Rapids bleaching facilities will be increased to meet demands of the new machine and of course pulpwood requirements at both mills will be increased.

Marathon

An experimental dairy feed additive field-tested by Marathon Corp. the past four winters shows promise as a ketosis preventative.

The product, tradenamed Maracarb NC, is a complex mixture of sodium and calcium salts of lignosulphonic and wood sugar acids. It is derived as a by-product of Marathon's process for the manufacture of purified lignosulphonates from spent sulphite pulping liquors. In the most recent tests it was fed, at a level ranging from 2% to 4% in formula feeds, to 83 herds comprising 2144 producing dairy cattle in Marathon County, Wis. Results indicate an apparent effectiveness of 84% for the product in the prevention of ketosis.

Marathon's Maracarb NC had been fed experimentally on a limited scale during the winters of 1951–52, 1952–53, and 1953–54. The results of these feeding tests were encouraging. Several cows which previously had been chronically afflicted with ketosis remained outwardly healthy and free of the disease throughout the feeding programs. As a result, considerably broader coverage for feeding experiments during the winter of 1954–55 was arranged through the office of the Marathon County Agricultural Agent.

During the period November, 1954, through April, 1955, approximately 90,000 lb. of Maracarb NC were distributed to 83 dairy farmers who cooperated in the field testing program. Maracarb NC was fed at an average rate of 0.23 lb. per cow per day to 2144 cows during a 180-day period when ketosis is usually most prevalent in this area. It was reported that there had been 259 cases of ketosis in these herds during the same period in the year prior to starting this field test. Only 41 cases were detected during the Maracarb NC feeding trial, indicating an apparent effectiveness of 84% for the product in the prevention of ketosis. In addition to results showing this marked reduction in clinical ketosis, information was obtained that indicated also a reduction in subclinical cases.

Ketosis, also called acetonemia and sugar sickness, is a noninfectious disease best described as a metabolic disturbance in cattle. It usually occurs after calving during the period of

high milk production. Biochemical and clinical studies over the past 30 years in both Europe and America have failed to determine the exact cause of the disease, despite the fact that it is one of the most common afflictions of dairy cows. Its occurrence is not limited to any particular geographical location, since it is a problem throughout all areas where high producing dairy herds are maintained.

C-Z

Two expansions have been announced by Crown Zellerbach Corp. for the North Portland, Ore., plant of its Western Waxed Paper Division. The first construction, to begin immediately, will double the present office area and add 10,000 sq. ft. of warehouse space. Completion is expected about the end of January.

The second phase involves building a new and larger warehouse to contain about 75,000 sq. ft., with construction beginning in the spring. Completion is scheduled for late next summer.

Flambeau

Roadbinder use of sulphite liquor from the Flambeau Paper Division, Kansas City Star Co., Park Falls, Wis., was 10.5 million gallons up to September 1, an increase of 90% over the 1954's previous high record. Meanwhile, the mill's experimental spray irrigation system disposed of 3.7 million gallons as against 0.6 gallons last year. An additional 2.5 million gallons was spread over a large soil filtration area, a new disposal project.

Total use and disposal up to September 1 was 16.7 million gallons in 1955 as compared with 6.1 million gallons last year. During the three critical hot-weather, low-water months ending September 1, the mill put on a high-cost sustained spurt that succeeded in disposing of 79.8% of all spent sulphite liquor produced (solids weight basis), one of the highest figures ever recorded in the American sulphite pulp industry.

As a further means of improving oxygen content of the river water, besides its major installation of aeration equipment at Pixley Dam, the company operated its three downstream power dams so that an inch or two of water continuously spilled over all the sluice gates. Resultant increase in absorbed oxygen supplied a large area below each dam in which aquatic life was well maintained.

I. P.

The Board of Directors of International Paper Co. have authorized further additions and improvements to the company's Mobile mill to provide for a new kraft paper machine.

The new 282-in. Beloit machine will have an annual capacity of 100,000 tops of unbleached kraft paper. A substantial part of this tonnage will consist of grades presently being produced at Mobile, which will be transferred to the new machine. Present machine capacity made available by this transfer will be used to increase the mill's production of bleached kraft paper grades.

This expansion is in addition to the mill's current expansion program announced last spring providing for the installation there of a newsprint machine with 100,000 tons annual capacity and related pulp mill, power, and other facilities. When this expansion program is completed, the Mobile mill will be the largest mill in the world manufacturing paper.

Although construction work was started on the company's newsprint mill during the spring, it will be possible to integrate this newly-authorized program with the work already in progress.

Both of the new machines are scheduled to begin operation during the summer of 1956.

Construction and equipment of the facilities for the new unbleached paper machine will add $18,000,000 to the $20,000,000 authorized earlier this year for the company's construction program at Mobile.

K-C

The use of spent liquor from Kimberly-Clark Corp.'s Neenah mill for road treatment projects is expected to top last year's record by more than 13%.

As of October 15, the corporation's fleet of a dozen tank trucks had hauled and spread on Wisconsin gravel roads actually more than last year's total high mark of more than 19 million gallons. By the end of the 1955 season, in excess of 22 million gallons will have been used for roadbinder.

Utilization of spent sulphite liquor to improve stream conditions in the Fox River has been an expanding program with Kimberly-Clark for more than 5 years.

A new spent sulphite liquor holding pond will add about 50% to the Kimberly mill's liquor storage capacity as another step in stream improvement of the Fox river. Earlier this year construction crews built up retaining walls of the existing ponds to boost their previous capacity by more than a million gallons.

Hammermill

Hammermill Paper Co., Erie, Pa., is operating a pilot plant using the Zimmerman process to treat spent sulphite liquor. The process involves treating the liquor with compressed air at 2200 p.s.i. and 300°C. in order to produce wet combustion of organic matter.

Champion-International

Kurtz M. Hanson, president of Champion-International Paper Co., Lawrence, Mass., was recently elected president of the Associated Industries of Massachusetts.

Glatfelter

The installation of P. H. Glatfelter Co.'s new paper machine will increase the amount of water used in the mill by less than 10%, and will add no additional solids to the mill's waste water.

Continental-Diamond

The Budd Co., Philadelphia, Pa., has purchased the Continental-Diamond Fibre Co., after making a diversification study in consultation with Robert S. Aries & Associates, New York, N.Y.

Bowaters

The Bowater Paper Corp. of England recently announced plans for a 100% stock dividend to holders of the parent company's shares of record November 21. Bowater's authorized capital under the plan would include £ 8.4 million of debt, 15 million shares of new 5½% cumulative preferred of £ 1 par, and 20 million shares of common of £ 1 par, of which 7,245,000 shares of preferred and 19.2 million shares of common would be outstanding. The Bowater's Lloyd Pulp & Paper Mills, Ltd., and the Mersey Paper Mills, Ltd., would be merged with Thames River Paper Mills, Ltd., under the name of Bowater's United Kingdom Pulp and Paper Mills, Ltd.

Downing Box

The Downing Box Co., Milwaukee, Wis., will begin construction shortly on its new building in Cedar Rapids, Iowa. The new plant will have 120,000 sq. ft. of floor space and will house a complete corrugating box factory equipped to manufacture corrugated shipping containers and certain specialty lines.

The new plant will initially employ approximately 50 employees and will eventually require 200 employees. Modern equipment, including a corrugating machine, printer-slotters and automatic taping and stitching machines, will be installed. The plant is well situated adjoining Milwaukee Road tracks in the north section of Cedar Rapids.

B. P. Bowen, who has been associated with Downing for

Wilfred Gallay, The E. B. Eddy Co.

S. P. Kaptain, St. Regis Paper Co.

23 years, will be the general manager of the Cedar Rapids plant.

E. B. Eddy

Wilfred Gallay, director of research for The E. B. Eddy Co., Hull, Que., has recently been presented with the 1955 Bolton Award for his outstanding thesis on the subject: "The Value of Better Mill Communications." In this Eighth Annual Essay Contest, sponsored by John W. Bolton & Sons, Inc., manufacturers of paper mill equipment of Lawrence, Mass., U.S.A., Mr. Gallay was awarded the second prize in the national competition which amounted to $750.

St. Regis

Construction is now well under way on the first pulp mill to be constructed in Alberta. The mill is being built by North Western Pulp & Power Ltd., a company jointly owned by St. Regis Paper Co., and North Canadian Oils Ltd., and will produce 150,000 tons of bleached sulphate pulp annually. St. Regis is directing the design and construction of the mill and will manage its operation.

There are now approximately 600 persons employed in the construction of the new mill. This is expected to increase to 1000 persons by the spring of 1956.

Steel framework for the supply storage buildings and the repair shop is up and 40% of the steel framework for the main pulp warehouse has been completed. Cement for the chip silos has been poured for their complete 94-ft. height and the construction engineers plan to pour cement for the pulp mill during the forthcoming winter months. The main administration and office building is under construction. Present indications are that the mill will be in operation as scheduled sometime early in 1957.

Foundations have been started for a power house which will contain two steam boilers with a capacity of 175,000 pounds per hour. One boiler will be fired by natural gas and the other by natural gas and wood bark.

Another of the work projects is the water settling basin which is 1800 ft. in length and approximately 300 ft. wide with a depth of 12 ft. Work is also proceeding on a water filtration basin.

The mill will use an estimated 25,000,000 gallons of water daily. A pumping station is under construction on the Athabaska River near the plant site.

Work has begun on laying the track required for spur lines which will connect with the main line of the Canadian National Railways at Hinton.

Operational cruising in preparation for next year's timber cutting is now under way on the 3000 square miles of timberlands on which the company has a long-term timber grant from Alberta. In addition, 3000 square miles of timberland have been granted to the company as a reserve. These 6000 square miles of timberlands are sufficient to support a pulp mill with an ultimate capacity of 350,000 tons annually. Cutting is expected to commence some time next fall with 175,000 cords to be cut then and 300,000 cords to be cut the following year.

When completed, the present mill will employ about 500 people. In addition, employment for approximately 1500 more persons will be provided in the woodlands operations.

Using lodgepole pine and white spruce, the mill will have the world's largest installation of the new Kamyr continuous cooking process and the first such installation in North America. This process makes it possible to control closely the variables in the cooking process and thus ensure more uniform pulp. In order to provide the whitest and brightest possible bleached pulp, two-stage chlorine dioxide bleaching will be provided in the six-stage bleach plant. The 450-ton Dominion-Minton drying machine will be totally enclosed and comprise 66 driers, probably the greatest number ever built into one unit. The dry end of the machine will be completed with automatic baling and weighing machinery to pack the sheets of pulp into 400-lb. bales.

St. Regis will handle the sale and distribution of Alberta Hi-Brite Kraft, which is the trade name for this kraft pulp, from its offices in the United States and Canada.

Consulting engineers for the project are H. A. Simons, Ltd., of Vancouver, B. C.

Stephen P. Kaptain, formerly director of wood research and development for southern woodlands, has been appointed resident manager of the St. Regis kraft pulp, paper, and board mill at Jacksonville, Fla.

Mead

The Operating Committee of the Kingsport, Tenn., Division of the Mead Corp. was established in 1949 to give supervisors of the mill an opportunity to discuss their many technical, administrative, and operating problems in joint meetings with representatives of Mead's top management and corporate department heads.

Person-to-person contacts between Kingsport people on the Operating Committee and the head office men, as they meet four times each year usually in two-day sessions, have facilitated a great many decisions and recommendations in regard to future plans and policies.

Improving the quality of all grades of paper made in the Kingsport mill was one of the foremost subjects at the last meeting of the Operating Committee, held in August. Sev-

Members of the Kingsport Operating Committee attending the August meeting, clockwise from Chairman E. H. Niederauer, center, are: S. W. Macbeth, G. H. Pringle, John D. Davis, R. C. Bradley, J. W. McSwiney, G. H. Sheets, R. C. Eisenbach, John Black, L. L. Mrachek, L. W. Hale, Charles Rodgers, James Evans, John Redd, John Taggert, R. H. Kemmerer and R. H. Savage. Mr. Rodgers represented W. R. Maull and Mr. Evans sat in for George Peters

eral changes expected to result in higher quality papers were considered and decision to make some of these changes was reached.

Some of the suggestions for further improving paper quality were installation of screens, addition of a new type reel, a better roll grinding service, putting in a new dynapulper, and the addition of an instrument for better control of weight variations.

Division manager E. H. Niederauer is chairman of the Operating Committee and Sydney W. Macbeth serves as secretary, keeping minutes of all meetings, including decisions and recommendations of the group. Each member is furnished a copy of these minutes as are other company representatives especially concerned with any particular subject under discussion.

Other Kingsport men on the Operating Committee are: George H. Sheets, operations; John Black, quality; George Peters, technical control; John Taggert, papermaking; R. C. Bradley, accounting; L. L. Mrachek, engineering; and R. H. Kemmerer, personnel.

Head office staff members of the Operating Committee include: G. H. Pringle, vice-president in charge of white paper operations; R. H. Savage, vice-president in charge of research and development; John D. Davis, director of product development; W. R. Maull, director of sales service; and L. W. Hale, manager of corporate accounting.

Other men representing either group attend meetings as occasion demands, either to present a subject for discussion or to furnish needed information.

Three main types of subjects come up for discussion by the Operating Committee: (1) grade and quality development of various papers made in Kingsport, (2) review of operating cost and other statistics, and (3) investigation and review of proposed expansion.

Back in 1949, when original meetings of the Operating Committee were held, some of the problems were how to improve the quality of coated papers, how to get higher pulp production, whether to build a new carbonate plant, whether to rebuild the water intake at the river, necessity for heating units in the new digester building, and whether it would be better to rebuild the hood on no. 2 paper machine or buy a custom-built hood.

Although many of these problems have been solved, the past 6 years have brought even more complex problems, such as the wider diversity of paper grades to be made, keener competition in both quality and cost, need for continued expansion and new equipment, refinement of manufacturing methods, selection of the most satisfactory machinery and solution of many technical difficulties.

One of the main advantages of getting together such a group as an Operating Committee is the saving of time in obtaining an exchange of opinion, suggestions, discussion, and decision on matters of interest to the various representatives from an operating, cost, or personnel point of view. Clarity of purpose is achieved and action is taken with a minimum of delay in time and other costs as the result of group planning and progress reporting.

I. P. C.

A. Neil McLeod has joined the staff of The Institute of Paper Chemistry, Appleton, Wis., as research associate in economics. He will engage in teaching and research in the broad field of economics and marketing as related to the paper industry. Curtis L. Brown has been appointed Bibliographer at the Institute.

Western Michigan

An enlarged staff in the paper technology field at Western Michigan College has begun a year of hard work with the largest enrollment that the department has ever enjoyed since the program's inception in Kalamazoo.

Western Michigan College paper technology staff: Miss C. Trittin, R. A. Diehm, E. E. Stephenson, A. H. Nadelman, and R. T. Elias

Alfred H. Nadelman has headed the instruction almost since the beginning of the program. R. T. Elias came to the faculty in 1952; New this year are Miss C. Trittin and R. A. Diehm, both formerly associated with the Ward Paper Co., Merrill, Wis. E. E. Stephenson is a former WMC student in paper technology now with the Sutherland Paper Co.

National Safety Council

New officers for the Pulp and Paper Section of the National Safety Council were elected at the Monday, October 17, session of the section at the 43rd National Safety Congress and Exposition in Chicago.

The officers, elected for the 1955–56 year, are: Francis H. Wagner, director of safety, The Mead Corp., Chillicothe, Ohio, *general chairman;* Fred O. Soughton, services and safety supervisor, Longlac Pulp and Paper Co., Ltd., Terrace Bay, Ontario *vice-chairman* and *program chairman;* Earl F. Ripstra, personnel manager, Container Corp. of America, Chicago *news letter editor*, and R. G. Belknap, personnel manager, Bemis Brother Bag Co., East Pepperell, Mass. *secretary* and *membership chairman.*

New Internal Bond Tester

The American Sisalkraft Corp., Attleboro, Mass., assisted by Kilham Engineering, Inc., has developed an instrument designed to measure the internal bond strength of kraft paper. The instrument is proving useful as a research tool for those concerned with the treatment of papers for specialized uses and is of utmost importance to all paper converters.

The Sisalkraft Internal Bond Tester, is now in use at Crocker Burbank & Co. Fitchburg, Mass., and The Brown Co., Berlin, N. H., as well as in use daily in the American Sisalkraft Research Laboratory at Attleboro. The instrument was developed as a result of cooperative testing programs by the above mentioned companies, and employing suggestions from American Cyanamid Co.

It has been found that this instrument provides a simple and accurate means of measuring the internal fiber bond properties of paper which is an important characteristic, particularly in the field of paper conversion. It is being sold by Testing Machines, Inc., 123 W. 64th St., New York 23, N.Y.

Company Publications

Although more than 6,000 company publications are being sent out regularly today, there still is an enormous number of firms without this important arm of communications.

Recently the International Council of Industrial Editors

set out to show the tangible results of company publications. Results indicate conclusively that such publications:

1. Help bring profits to the sponsoring company, and
2. Help their readers earn better and steadier paychecks.

Editors today, says the ICIE, "are no longer blasting with a shotgun at vague targets and then forgetting it. They are developing year 'round communications programs which take consistent, timed, and accurate shots at well mapped targets. . . ."

In the sales field such "rifle shooting" pays off in direct hits. The Ford Dealer Magazine, for instance, ran a piece about a customer service plan used by an Ohio dealer. A California dealer copied the idea and upped his service volume $2000 per month.

Dupont Magazine presented a comprehensive article on a new plastic. Result was a $50,000 increase in sales.

New York Central's employee magazine *Headlight* invites reader suggestions—frequently gets inside tips that lead to orders for freight and passenger volume.

Match Tips, Ohio Match Co.'s employee book, produced an 80% drop in towel loss as the result of a publicity program pointing out the cost.

A series of feature articles on reducing scrap and spoilage in the Delco-Remy *Clan* resulted in a material saving of 43.7% within 30 days.

Featuring a safety article, Bucyrus-Erie Co.'s *Scoop* editor reported a 30% increase in demand for new safety glasses. This was followed by a 50% decrease in eye accidents.

Such results are common—for all types of companies with all types of objectives. House publications do pay off. Whether for employees, distributors, retail outlets, or prospects, there is apparently no limit to the accomplishments that can be credited to intelligently planned, attractively produced company publications.

Borden's

The Monomer-Polymer Dept. of the Borden Co's Chemical Division, 511 Lancaster St., Leominster, Mass., has issued a catalog covering more than 400 chemicals for use in the polymerization field.

DuPont

The following appointments have been made by the Polychemicals Dept. of E. I. du Pont de Nemours & Co. of Wilmington, Del.: John H. Daughtridge and Russell C. Weigel, directors of sales; Arthur M. Cole, assistant director of sales in the industrial chemicals field; Jerry D. Shaw, and C. D. Bell, assistant directors of sales under Mr. Weigel; Frank G. Keenen, product manager for ammonia and related products; Robert R. Warner, product manager for methanol and other chemicals; Richard D. Scheer, manager of industrial chemical sales; William S. Robertson, assistant manager of industrial chemical sales; T. A. Parriot, sales manager for "Zerone" and "Zerex"; Francis M. Jornlin, manager of nitrogen product sales; Meyers F. Gribbins, assistant manager of nitrogen product sales; William W. Beck, acting manager of sales training and personnel; Marshall A. Stephens, assistant manager of "Zerone" and "Zerex" sales; F. E. Wintzer, marketing manager of "Butacite" polyvinyl butyral resin; Stuart P. Miller, assistant to the directors of sales; H. LeRoy Corkran, special duties in the staff group reporting to the directors of sales; George W. Read, assistant manager, marketing analysis and sales controls; William A. Franta, marketing manager of "Teflon" tetrafluoroethylene resin; Robert A. Kellar, assistant marketing manager for "Teflon" tetrafluoroethylene resin; Albert A. Pavlic, manager, plastic resin sales; Bailey H. Barnes, assistant manager, plastic resin sales; Henry M. Cadot, product manager for "Zytel" nylon resin; Herbert S. Lecky, product manager for "Alathon" polyethylene resin; Raymond E. Brady, product manager for "Lucite" acrylic resin; William E. Grigsby, manager of sales technical services; Doyce B. Hanson, director of the department's sales service laboratory at Chestnut Run; Russell Akin, assistant manager of sales technical services; Milton J. Roedel, manager of a new section devoted to end use development; R. Jack Manning, marketing manager for "Tynex" nylon monofilament, "Pyralin" cellulose nitrate, and "Plastacele" cellulose acetate; Edwin K. Keller, assistant marketing manager for "Tynex" nylon monofilament, "Pyralin" cellulose nitrate, and "Plastacele" cellulose acetate.

Black-Clawson

The Black-Clawson Co. has acquired the complete line of Downingtown suction rolls and structural board forming machinery business. B-C recently terminated the manufacturing activities of Downingtown after acquiring the company's assets.

Stein, Hall

Emmett P. Kavanaugh has been appointed sales technician servicing the paper industry in Pennsylvania and parts of Virginia for Stein, Hall, & Co., New York.

Hooker

Hooker Electrochemical Co. and Niagara Alkali Co. have approved a formal agreement for the consolidation of the two companies.

G.E.

General Electric Co., Schenectady, N.Y., has issued a bulletin (GEA-6131A) on lever and rotating cam type limit switches.

Pilot Plant operations have started at G.E.'s new plant near Roanoke, Va. The 600,000-sq. ft. structure will house manufacturing and office facilities for the company's Industry Control Department.

Fleck

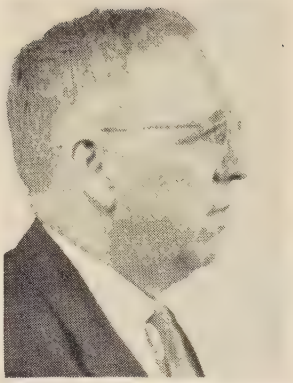
Victor T. B. Williams has joined the staff of the Alexander Fleck Ltd., Ottawa, Ont., as sales manager.

Stickle

Stickle Steam Specialties Co., 2209 Valley Ave., Indianapolis, Ind., has issued a bulletin (No. 560) describing the new Stickle automatic temperature control for individual wet end dryers.

The annual meeting of American Cyanamid Co.'s Paper Chemicals Department was held October 10–12 at the company's research laboratories at Stamford, Conn. Present at the meeting were: the department's management, field sales representatives, personnel of the department's application laboratory in Chicago, and personnel of the paper chemicals research laboratories from Stamford. The group discussed Cyanamid research projects underway and market trends in the paper industry

D. M. Pierce, The Pusey & Jones Corp.



S. M. Bratton, The Pusey & Jones Corp.

P. & J.

Daniel M. Pierce has been appointed president and general manager of The Pusey and Jones Corp., Wilmington, Del., and S. M. Bratton has been elected a vice-president. Sidney G. Briscoe has been appointed general sales manager of the Pusey & Jones paper machine division.

Graver

Graver Water Conditioning Co., 216 W. 14th St., New York, N. Y., has developed a new type of spray valve for use with its deaerating heaters and hot process softeners.

Hercules

Hercules Powder Co. has announced plans for the construction of a plant at Parlin, N. J., for the production of a new-type high molecular weight polyethylene. The new plant will utilize the Ziegler process, under license from the Farbwerke Hoechst AG in Germany.

Hercules has issued a booklet containing the photographs and brief biographical sketches of the 48 men in the Paper Makers Chemical Dept.

Hercules has announced plans for expansion of its rosin and rosin size plant at Savannah, Ga. Part of the new plant will include a unit for the processing of crude tall oil.

Reliance

Reliance Electric & Engineering Co., 1088 Ivanhoe Road, Cleveland 10, Ohio, is offering a new low cost tension regulating drive, designated Reliance VS-100 Drive, for center winding a wide variety of materials without any physical tie-in between the main machine and the winding section.

General Aniline

General Aniline & Film Corp. will expand its activities in the liquid detergent field by construction of a new surfactants manufacturing building at Calvert City, Ky., installation of additional facilities at the Company's Linden, N. J., plant, and leasing of large storage tank facilities in Los Angeles and Alameda, Calif.

Dorr-Oliver

Dorr-Oliver Inc., Stamford, Conn., has issued a bulletin (No. 3302), describing the physical characteristics, design features, principal of operation, applications, and advantages of the Oliver Webwelder for splicing side rolls of paper.

Dorr-Oliver has made the following transfers in its sales department: Thomas C. Reeves from Eastern Filtration Division, Asheville, N. C., to Central Filtration & Industrial Division, Dallas, Tex.; George H. Koenitzer from Eastern Sanitary Division, Stamford, Conn., to Central Sanitary Division, Cleveland, Ohio; Thomas V. Barton from Western Filtration Division, Oakland, Cal., to Eastern Filtration Division, Stamford; and William M. Smith of Central Filtration & Industrial Division from Chicago, Ill., to Cleveland.

Nopco

Joseph E. Connell and Robert J. Kingsley have been named sales managers of new sales departments set up by the Pacific Division of the Nopco Chemical Co.

Permutit

The Permutit Co., 330 W. 42nd St., New York 36, N. Y., has issued a bulletin (No. 4178), illustrating the advantages of cubicle instrumentation for filters, water softeners, and various ion exchangers.

Pennsylvania Industrial Chemical

Pennsylvania Industrial Chemical Corp., Clairton, Pa., has opened a new West Coast district office in Los Angeles, under Arthur Patureau, manager.

Snell

William A. Ladd has joined the staff of Foster D. Snell, Inc., New York, N.Y., as an electron microscopist.

Witco

Witco Chemical Co., 122 E. 42nd St., New York 17, N. Y., has published technical service bulletin (M-15) describing Witco Paste No. 253, a new chemical product for improving processing properties and characteristics of coating formulations for machine coated papers.

Ingersoll-Rand

Ingersoll-Rand, 11 Broadway, New York 4, N. Y., has issued a bulletin (Form 7325) describing a new type of centrifugal pump for paper stock and industrial liquids. The new pump features a diverging type impeller, enabling it to handle liquids containing large concentrations of solids, air, and gases.

Huyckfelt

Stanley B. Huss has joined the staff of F. C. Huyck & Sons, Rensselaer, N.Y.

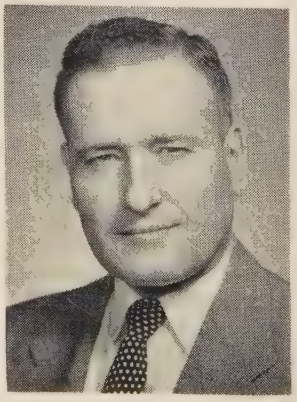
Jim Evans has been appointed to the field service engineering staff of Huyck.

Huyckfelt has taken an option on a 200-acre site at Aliceville, Ala.

Bolton

John W. Bolton & Sons, Inc., Lawrence, Mass., has appointed Pulp & Paper Mill Accessories, Ltd., Montreal, Que., as full line sales representatives for the Bolton Co. and its Emerson Manufacturing Co. division in Eastern Canada.

Haigh M. Reiniger has been appointed vice-president of Bolton in charge of sales, succeeding A. C. Clarke, who retired recently.



S. B. Huss, F. C. Huyck & Sons

H. M. Reiniger, John W. Bolton & Sons, Inc.

LANGSTON

Louis J. Baudis has been elected vice-president in charge of engineering and manufacturing of the Samuel M. Langston Co., Camden, N. J.

TRAMRAIL

The Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has issued a booklet (No. 2008-L) featuring engineering and application data on Tramrail overhead tracks and automatic materials handling equipment.

SANDOZ

Sandoz Chemical Works, Inc., 61–63 Van Dam St., New York 13, N. Y., has issued a bulletin describing Sandopan DTC, a new type surfactant for use in cotton, wool, rayon, and synthetic processing. A new surfactant is claimed to have outstanding deinking and felt-washing properties.

HYGROTESTER

Hygrotester Inc., P. O. Box 923, Brooklyn 1, N. Y., has published a brochure (No. 101/56) describing hygrotester indicating and recording moisture measuring equipment.

ALBANY

Albany Felt Co., Albany, N. Y., is producing a new needled-construction felt, specifically designed for the asbestos-cement field.

NALCO

National Aluminate Corp., 6216 W. 66th Place, Chicago 38, Ill., has issued a bulletin (No. Z–1) describing the Nalcite HCR hot lime-zeolite water treatment technique.

BABCOCK & WILCOX

The Tubular Products Division of the Babcock & Wilcox Co., has published a chart showing the approximate relation between hardness, as measured by various testing systems and tensile strength of carbon and alloy steels.

DOW

The Dow Chemical Co., Midland, Mich., is now producing commercial quantities of its paper coating grade of polyethylene, Dow Polyethylene 700 C.

Commercial production of soda ash has started at Dow's new $3,000,000 Freeport, Tex., plant.

PYROXYLIN

Pyroxylin Products, Chicago, Ill., is offering a new thermoplastic adhesive, Proxmelt 36-32-10, for sealing foil and paper mounted foil.

OBITUARIES

David Clark Everest

David Clark Everest, retired chairman of the Marathon Corp., died in the Wausau Memorial Hospital, Wausau, Wis., on Oct. 28, 1955.

Mr. Everest was born in Pine Grove, Mich., on Oct. 13, 1883. He received honorary doctorate degrees from Northland College and Laurence College (Institute of Paper Chemistry).

He started in the paper industry as a bookkeeper for the Bryant Paper Co., Kalamazoo, Mich., in 1900. From 1902–07 he was assistant manager of the Munising Paper Co., Munising, Mich. He was manager of the Williams-Gray Co. in Chicago, Ill., from 1907–09 and became manager of the Marathon Corp., Rothschild, Wis., in 1909. In 1938 he became president and chairman of the board in 1950.

David Clark Everest

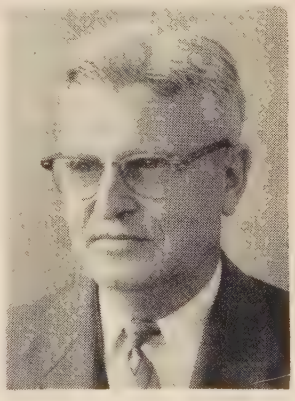
He was also chairman of the board of the Wausau Paper Mills, Brokaw, Wis.; vice-president, First American State Bank, Wausau; vice-president, Masonite Corp., Laurel, Miss.; vice-president, Longview Fibre Co., Longview, Wash.; vice-president, Mutual Liability Insurance Co., Wausau, Wis.; chairman, Marathon Mills of Canada, Marathon, Ont.; vice-president, Board of Trustees, Institute of Paper Chemistry, Laurence College, Appleton, Wis.; president, American Paper & Pulp Association; and president, American Forestry Association.

He was a member of the Executive Committee of the Technical Association of the Pulp and Paper Industry in 1927 and was the recipient of the TAPPI gold medal in 1944. This award is made to a person who has made outstanding contributions to the technical advancement of the pulp and paper industry.

John C. Wood

John Carpenter Wood, vice-president of all Kalamazoo Vegetable Parchment Co. manufacturing operations in the United States died at Bronson Hospital, Kalamazoo, Mich., on Oct. 21, 1955, following a heart attack.

Mr. Wood was born in Springfield, Ill., on Aug. 19, 1900, and graduated from the University of Michigan as a chemical engineer in 1923. He entered the employ of KVP Co. immediately following graduation. Starting as a helper on a waxing machine he worked through the engineering and cost departments until 1943 when he became superintendent of all converting operations such as printing, shipping, finishing, and waxing. He became vice-president in 1947, continuing in that capacity until his death.



John C. Wood

He is survived by his wife, Frances; a daughter, Carolyn; three sisters and one brother.

He became a member of the Technical Association of the Pulp and Paper Industry in 1925.

Dirt in Paper*

Revision of Tentative Standard T 437 m-43

(THIS STANDARD IS UNDER THE JURISDICTION OF THE PAPER TESTING COMMITTEE)

THIS method (*1*, *2*) is adapted to the numerical estimation of dirt in paper in terms of area and, if desired, number. For Dirt in Pulp *see* T 213 m.

Dirt in paper is defined as any foreign matter which is embedded in a sheet, which has a marked contrasting color to the rest of the sheet when viewed by reflected light, and which has an equivalent black area of 0.04 sq. mm. or more. The equivalent black area of a dirt spot is defined as the area of a black spot on a white background which would make the same visual impression as does the dirt spot itself on the particular background in which it is embedded. Consequently, the estimated equivalent black area of a gray or colored spot would be smaller than its actual area in inverse proportion to the intensity of its color, and the equivalent area of a black spot in a gray or colored background would also be smaller than its actual area.

APPARATUS

1. *Standard Comparison Chart*, having a series of pairs of black spots of various shapes and areas photographed on a transparent film or on a white background. The chart may be obtained from the Secretary of the Association and is the same as for TAPPI Standard T 213 m.

Note: Greater accuracy may be obtained using the transparent chart because of the proximity of the comparison spots to the dirt spots in the test specimen.

2. *Light Meter*, of any standard manufacture, indicating light intensity in foot candles. Required for measuring the illumination on the test sample.

TEST SPECIMEN

Take sample sheets from the shipment of paper according to the standard sampling method, T 400 m. An area of at least 2000 sq. cm. (about 320 sq. in.) of paper sheets is required for each examination. The specimen pieces comprising the sample may be of any convenient size, but of such area as to give a total of between 20 and 30 readings for each test; that is, the sample might consist of 10 sheets, each side having an area of at least 200 sq. cm., or 15 sheets, with each side having an area of at least 133 sq. cm.

* This method has been approved as a tentative standard by the Standards Committee. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 155 E. 55th St., New York 17, N. Y.

PROCEDURE

In turn, lay each test sheet on a white background (a piece of stiff paper or paperboard is suitable) and illuminate with adequate lighting placed 4 feet directly above the inspection table to provide the equivalent of 40 to 60 foot candles on the test sheet. When using the standard chart photographed on a white background, hold the chart with its edge over the test specimen. If using the transparent chart, place it directly on the test specimen. Examine each dirt speck and, from the chart, estimate its equivalent black area and record and include it in the total reading if equal to or greater than 0.04 sq. mm. Examine both sides of each specimen. If after the 20 to 30 readings have been taken, any individual readings are more than three times the average, inspect a further set of specimen sheets to determine whether such high readings are justified and, if not, reduce the readings in question to three times the average. An odd piece of dirt which is obviously unusual and not representative of the shipment should be completely ignored. Shives or spots which appear dark only at some angle of observation are not considered as dirt. Determine, by measurement, the total area of the sheets examined.

REPORT

Report the average of all measurements as square millimeters of equivalent black area per square meter of surface examined—i.e., in parts per million. Report also the total area of paper examined.

REPRODUCIBILITY OF RESULTS

Duplicate tests on the same shipment of paper are expected to agree within 10% with the same observer, and within 20% for different observers.

ADDITIONAL INFORMATION

The 1955 revision differs from the previous in that (1) the 1933 chart has been dropped; (2) the illumination is specified in foot candles; (3) the area of the minimum significant spot is reduced from 0.08 to 0.04 sq. mm.

LITERATURE CITED

1. Clark, J. d'A., von Hazmburg, R. S., and Knoll, R. J., "The

Estimation of Dirt and Shives in Pulp and Paper," *Paper Trade J.* 96, No. 5:40 (Feb. 2, 1933).

2. Clark, J. d'A., "Method of Estimating Dirt in Pulp and Paper," *Paper Trade J.* 96, No. 26:27 (June 29, 1933).

REFERENCE

Adrian, Alan P., and Graff, John H., "Comparative Evaluation of the Different Methods of Dirt Count in Paper," *Paper Trade J.* 111, No. 19:32 (Nov. 7, 1940).

Identification of Wire Side of Paper*

Revision of Tentative Standard T 455 m-53

(THIS STANDARD IS UNDER THE JURISDICTION OF THE PAPER TESTING COMMITTEE)

THE wire side of paper is the side that was in contact with the wire of the paper machine; the other side is termed the felt or top side. It is desirable to have means of distinguishing between the two sides because they generally differ in some physical and chemical characteristics. It is not always possible to make the distinction, particularly with coated and other surface-treated papers, certain high-grade papers made from well beaten rag stock, and specialties made with variations in the usual paper-machine practice. When one of the following procedures does not give a definite indication, it is advisable to try one or more of the other procedures.

PROCEDURES

1. Fold over a sheet of the paper and observe the relative smoothness of the two sides. Often the pattern of diamond-shaped impressions of the machine wire can be seen, thus identifying the wire side. In viewing the paper, it should be held in a horizontal position with the light striking it at an angle of about 45° and with the line of vision of the eye also at an angle of 45° to the surface of the paper. Observation with a microscope is helpful.

2. Dip the paper in water or in a weak caustic soda solution, drain off the excess liquid, allow to stand a few minutes, and again examine the two sides. This treatment tends to restore to paper the texture it had on the machine wire. View as described in 1.

3. Hold a sheet of paper in one hand in such a way that the grain (machine) direction is parallel to the line of vision and the sheet surface is approximately horizontal. Holding the sheet in this position with one hand, pull upward with the other to start a tear in the sheet so that the line of tear follows the grain of the paper. As the tear is being made, gradually guide it so that it moves in the cross direction and toward the outer edge of the sheet, producing a tear line following a curved path. Turn the sheet over so that the opposite side is uppermost and make a similar tear in the sheet. Observe the feathering caused by the splitting of the sheet at the edge of the two tears which have been made. One of these tears will show a distinct feather edge as compared to the other, especially in the curved portion where the line of tear departs from the grain or machine direction and moves toward the cross direction. The tear with the more feathered edge is always made when the wire side of the sheet faces upward.

This procedure is very useful as it often gives a positive determination when the other simpler procedures fail. The successful use of it, however, requires a certain amount of experience and it is recommended that such experience be gained by applying it to papers of known wire side and felt side.

ADDITIONAL INFORMATION

In this revision, procedure 4 of T 455 m-53 (the curl test) has been deleted as several comments have been received that it is unreliable.

* This method has been approved as a tentative standard by the Standards Committee. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

Analysis and Testing of Highly Opaque Pigments*

TAPPI Suggested Method T 651 sm-55

(THIS SUGGESTED METHOD IS UNDER THE JURISDICTION OF THE NONFIBROUS MATERIALS TESTING COMMITTEE)

THIS method deals with the testing of synthetic opaque white pigments commonly used as paper fillers and for coating colors. These materials are characterized by having a much higher refractive index than clay, calcium carbonate, talc, calcium sulphate, satin white, etc. They include such titanium pigments as anatase titanium dioxide; rutile titanium dioxide; and composites of rutile titanium dioxide with calcium sulphate anhydrite, zinc sulphide, lithopones and/or zinc oxide.

* This method is suggested by the Standards Committee as being the most suitable to date. It is *not*, however, a TAPPI Standard. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

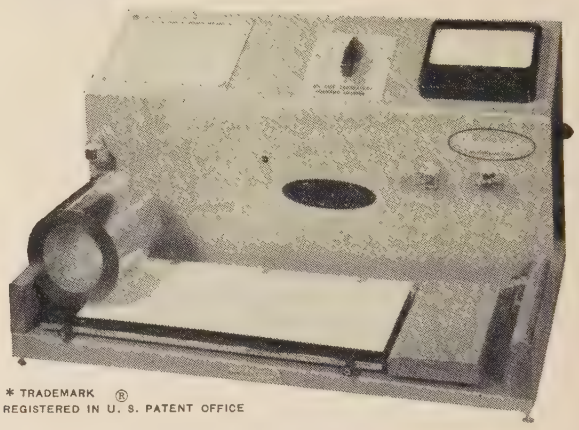
PAPER MANUFACTURERS AND PRINTERS RECOMMEND THE

THE "VANCEOMETER" is the outstanding photoelectric absorption tester in the Paper Industry and Allied Fields.

- To obtain a numerical rating of printability.
- To obtain a numerical rating of absorption into paper and paper board.
- To measure the receptivity of paper and paper board for sizing, coating, adhesive, ink, etc.
- To test plain or colored stock.
- To get results in less than one minute.

For complete information write for free Technical Bulletin

Vanceometer* Oil Absorption Tester



* TRADEMARK ® REGISTERED IN U. S. PATENT OFFICE

HILLSIDE LABORATORY

333 NORTH MICHIGAN AVENUE CHICAGO 1, ILLINOIS

SAMPLING

These opaque pigments are shipped in 50-pound bags. Remove individual samples of approximately 100 grams from each bag sampled. The number of bags so sampled shall be not less than 1% of all those in the shipment and not less than six bags for shipments of six bags or more. The gross sample shall be at least 600 grams and shall be thoroughly mixed.

MOISTURE

Determine moisture in accordance with TAPPI Standard T 645 m, Analysis of Clay.

pH VALUE

Use the apparatus and procedure given in T 645 m, employing 10 grams of pigment to 90 ml. of water.

GRIT

Follow the procedure given in T 645 m.

Note: There is considerable doubt as to whether there is any correlation between sieve tests for "grit" as applied to highly opaque pigments and the occurrence of aggregates in papers filled or coated with them, and for routine testing the following simple method may be used:

Mix 20 grams of pigment in 350 ml. of distilled water for 1 minute, using a malted milk (Hamilton Beach) mixer with high-speed setting, and pour the slurry on a 325-mesh sieve, rinsing the mixing cup onto the sieve. Then place the sieve in an aluminum pan and pass distilled water into the pan between the wall of the sieve and the wall of the pan. Continue rinsing the residual material by gently moving the sieve up and down until a clear effluent is obtained. Transfer the residue to a small tared beaker, using a wash bottle. Decant most of the water, dry and weigh the beaker and residue. Alternatively, if a 3-inch diameter sieve is used, the residue may be dried and weighed directly on the sieve.

BRIGHTNESS

Determine the brightness of the dry pigment in accordance with T 646 m, Brightness of Clay, using a packing pressure of 50 p.s.i. instead of 30 p.s.i.

Note: Brightness in most cases reflects the degree of packing and may or may not correlate with practical application when the pigment is used in a vehicle. The preparation of standard coating colors and their application under controlled conditions with comparisons with suitable standards would give more pertinent data.

CHEMICAL ANALYSIS

Determine titanium dioxide in accordance with T 627 m, Determination of Titanium Dioxide, and zinc in accordance with T 438 m, Zinc Pigments in Paper, using a sample weighing 0.2 to 0.4 gram.

ADDITIONAL INFORMATION

The following publications of the American Society for Testing Materials are of interest to those using opaque white pigments:

1. Methods of test for:
   Chemical Analysis of White Pigments, D 34–51 T.
   Specific Gravity of Pigments, D 153–52 T.
   Hygroscopic Moisture (and Other Matter Volatile under the Test Conditions) in Pigments, D 280–33.
   Oil Absorption of Pigments, D 281–31.
   Tinting Strength of White Pigments, D 332–36.
   Hiding Power, Relative Dry, of White Pigments in a Linseed Oil Vehicle, D 406–39.
   Common Properties of Certain Pigments, D 1208–52 T.
   Fineness of Dispersion of Pigment-Vehicle Systems, D 1210–52 T.
2. Specifications for:
   Titanium Dioxide Pigments, D 476–48.
   Zinc Oxide, D 79–44.
   Zinc Sulphide Pigments, D 477–45.

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Southeastern

The first meeting of the Southeastern Section of the 1955–1956 season was held at Savannah, Ga., on Sept. 30, 1955.

After a social hour the members and guests assembled for dinner in the ballroom of the DeSoto Hotel. Immediately following dinner, Chairman C. N. Rogers called the meeting to order and introduced C. N. Adams, general superintendent of Southern Paperboard Corp. Mr. Adams gave the welcoming address and presented some statistics on Southern Paperboard's operations in Savannah.

Chairman Rogers brought to the attention of the group the tours which were available Saturday morning. One of the trips was to the Southern Paperboard plant and the other to the Savannah Sugar Refining Corp. He also announced a registration of about 165 members and guests.

The program chairman, Richard R. Chase, was called upon to introduce the speakers of the evening.

The first paper was given by A. H. Putnam of West Virginia Pulp & Paper Co. The paper was entitled "Construction of an Isolarium."

The second paper, "Application of the Conductometric Method to Routine Sodium Analysis of Caustic Sludge," was given by J. W. Cameron of National Container Corp.

The third paper presented was entitled "Deterioration of Southern Pine Kraft Pulp in High Density Storage," and given by J. E. Ayer, University of Alabama. This paper was presented at the Alkaline Pulping Conference and will be published in a later issue of *Tappi*.

The fourth paper by C. E. Libby, North Carolina State College, was "Objectives of the Curriculum in the Pulp and Paper Technology at North Carolina State College."

C. L. Smith, *Recording Secretary*

Construction of an Isolarium

A. H. Putnam

Several months ago, the Charleston mill of the West Virginia Pulp & Paper Co. decided that the moisture content of paper at the time the paper was being tested had sufficient influence on the test results to warrant investigation. In order to determine the effect of moisture content on the strength of paper, it was first necessary to know the exact moisture content of the paper sample at the time strength tests were being made.

To illustrate and clarify this, consider the case of a paper sheet that contains 3% moisture being tested in a room where the relative humidity is 50% and the temperature is 73°F. If the paper were in equilibrium with these atmospheric conditions, it would normally have a moisture content of over 7%. However, in the example just cited, the sheet would contain 3% moisture when the testing first started, but when exposed to the surrounding atmosphere would absorb moisture so rapidly that it would be impossible to know the exact moisture content at the instant a tear or rupture occurred during the test. Thus, for accuracy, it was necessary to surround the paper sample during testing with an atmosphere which had a moisture content that was in equilibrium with that of the paper. To provide this surrounding atmosphere, the isolarium was built.

Several conditioning chambers of a permanent-type construction have been described in various technical magazines, but for the purposes of this investigation, they were considered unsuitable since their construction costs would have been high and the delay for construction was undesirable. The conditioning chamber to be described filled our needs satisfactorily in that it was very inexpensive, easily built, and, in a sense, was disposable.

The conditioning chamber that was built at the Charleston mill was made of polyethylene plastic, and called the "isolarium." First of all, a wooden frame that was 8 ft. long, 4 ft. wide, and 4 ft. high was built atop a large table in the paper testing, constant humidity room. Inside this framing, a plastic bag of approximately these dimensions was constructed and suspended from the framing. This provided a conditioning chamber having a volume of approximately 128 cu. ft.

The plastic that was to be used for constructing this isolarium arrived in a roll as a tube of some 30 in. diameter. This plastic was 0.003 in. thick and was highly flexible. The sides, top, and bottom panels were cut to size from this plastic tubing, and fastened together with a heat sealed seam.

The sealing of these seams was a relatively simple process, requiring nothing more elaborate than a housewife's ordinary

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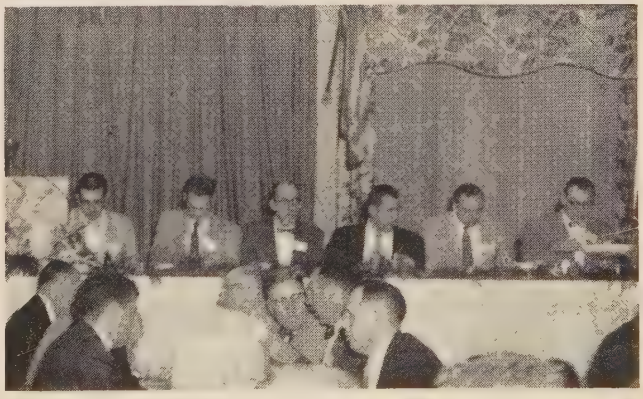
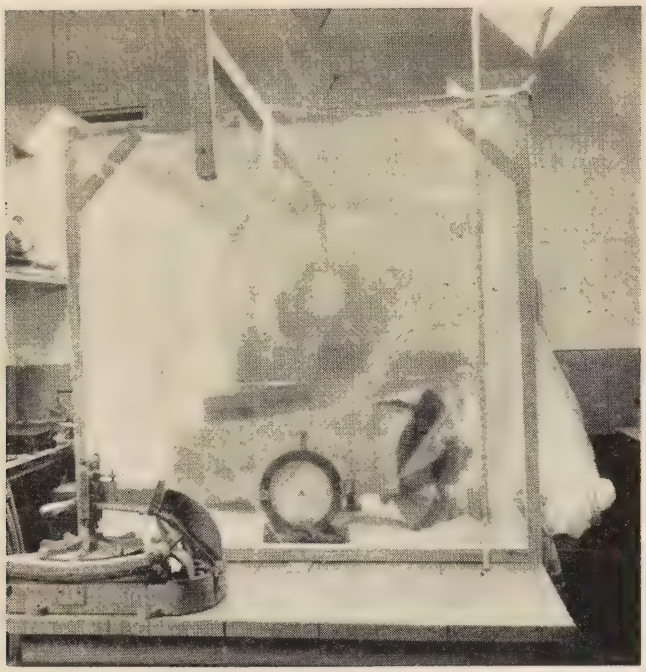


Head table at the meeting of the Southeastern section of TAPPI



The isolarium

electric iron, two strips of aluminum foil, and a small block of wood. In making these seams, a 2 ft. length of 2-in. square wood was laid on the table, and covered by one of the strips of 3-in. aluminum foil. On top of this, the two edges of the plastic that were to be sealed together were placed and covered with the second piece of metal foil. Pressure and heat were applied to this top piece of foil with an electric iron, and the iron was slowly moved the length of the wood block. With a few minutes practice, anyone can soon find the most desirable temperature for the iron and the amount of pressure necessary to obtain a good seal. When the two strips of metal foil are removed from the plastic, a bonding between the two sheets of plastic should result that is approximately the width of the block of wood underneath. These wide seams are sufficiently strong to withstand any shock that may result during the time tests are being conducted. After the top, sides, and bottom panels were sealed together, sleeves were sealed onto the sides of the unit by the same process that was used in sealing the larger panels together. These sleeves were of course installed so that testers could reach inside the isolarium and test the paper samples. As can be imagined, the seams that hold the sleeves to the side of the isolarium are the most critical since they receive the most abuse of any, so particular attention was paid them when they were installed.

Celluloid windows were next installed to provide better observation of the testing inside the isolarium. As was true with two sheets of the plastic, no solvent or adhesive was found that would glue the celluloid and plastic together with sufficient strength to withstand any tension. When the windows were installed, several thicknesses of the plastic were sewed around the edge of the celluloid in the form of a border. Colloidon was used to seal the holes where the celluloid and the plastic were sewed together, then the plastic border was heat-sealed onto the side panels in the desired location, and the plastic sheet cut from behind the glassine.

This completes the details of the construction of the isolarium. A large trapdoor was left open on one side of the unit where testing machines could be inserted into the isolarium. Before anything was introduced into the isolarium, however, several sheets of heavy board were laid on top of the bottom panel as a protective floor covering—otherwise the weight of the testers might have pounched holes through the plastic sheet underneath. After the floor covering was inserted, next came the Elmendorf tear tester, a Thwing-Albert tensile tester, a Mullen tester, a set of balances, and a clothes line type of holder for the paper samples. A blower arrangement that was to be used in controlling the humidity within the isolarium was also inserted and then the final flap was sealed.

The relative humidity within the isolarium was controlled by the blower arrangement in the following manner:

An electric fan was installed in the end of a large cardboard box. Ten-inch circles were cut from the top of the box, and rotap screens were inserted into these holes. A layer of commercial grade silica gel was poured into the screens. Then when the fan was started, the air within the isolarium was circulated through the bed of silica gel. The desired relative humidity within the isolarium was controlled by varying the amount of silica gel in the screens and by admitting fresh air into the isolarium.

Enough silica gel was poured into the screens that after a 24-hr. period of circulation, the atmosphere within the isolarium had a relative humidity of 4%, according to the hair-hygrometer humidity recorder inside the isolarium. This condition was maintained for an additional 24 hr. to make sure that all the paper samples hanging on the rack inside were in equilibrium with the surrounding atmosphere. This precuation was deemed necessary so that no moisture content hysteresis effect would cause inaccurate test results. Next, some of the silica gel was removed, and enough fresh air was admitted to raise the relative humidity to 10%. This condition was maintained for 48 hr. to bring the moisture content of the paper samples to equilibrium with that of the atmosphere inside the isolarium. After this conditioning period, the various tests were made on the paper samples by rubber-gloved operators who reached through the sleeves in the side of the isolarium to the various testing machines. When this phase of the testing was completed, more silica gel was removed, more fresh air was admitted, and the relative humidity was allowed to rise to 20%, and again this condition was maintained within the isolarium for a period of 48 hr. so that the samples could reach equilibrium with the surrounding atmosphere. Testing was done at these conditions, and the same procedure was followed at relative humidities of 30, 40, and 50%. All tests were conducted at 73°F. One set of tests were conducted at 73% relative humidity, also. These atmospheric conditions were attained by removing the screens containing silica gel, and inserting shallow pans of saturated brine solution inside the isolarium. The lower humidities could have also been obtained by inserting trays of saturated solutions of different chemicals, but when this is done, there is always the increased possibility of accidentally spilling one of the trays and ruining some of the paper samples that are to be tested. If this should happen, then, of course, the entire sequence of tests would have to be repeated from the beginning.

In order to determine the moisture content of the paper at the different atmospheric conditions, the following method

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C. N. Rogers, Sonoco Products Co.

proved satisfactory: 12 square foot samples of paper were hung inside the isolarium and were subjected to all the conditioning with the samples that were to be tested. At the levels of different relative humidities where testing was performed, these 12 samples were weighed at each of the atmospheric plateaus. When the tests were complete, the 12 paper samples were removed from the isolarium, and hung up for 48 hr. in our paper testing lab where an atmosphere of 50% R.H. and 73 °F. is maintained. These samples were then reweighed and a moisture content determination was made in accordance with TAPPI methods. When the moisture-free weight of the pulp was determined, it was a simple calculation to determine the moisture content of the paper at each of the different atmospheric conditions.

This has been a description of the procedure used for testing paper samples having different moisture contents, and of the details of construction of the conditioning chamber, or isolarium, that made these tests possible. Should any one be considering such an investigation, or any similar study, you might find an isolarium such as that just described will suit your needs.

PRESENTED at the meeting of the Southeastern Section of TAPPI, Savannah, Ga., Sept. 30, 1955.

Application of the Conductometric Method to Routine Sodium Analysis of Caustic Sludge

James W. Cameron, Jr.

THE object of the conductometric sodium test is to determine the sodium content (as Na_2O) of clarifier and filter caustic sludge. Clarifier sludge is settled caustic sludge from the white liquor clarifier tanks. Filter sludge is settled caustic sludge from the white liquor clarifier tanks after it has been washed in the lime mud thickener, and passed over a continuous rotary vacuum filter prior to entering the lime kiln. The clarifier sludge contains mainly calcium and carbonate ions, and to a lesser degree sodium, hydroxide, sulphide, and thiosulphate ions, and to a small degree sulphate and aluminum as well as other ions. The filter sludge contains principally calcium and carbonate ions with small amounts of sodium, hydroxide, sulphate, thiosulphate, sulphide, iron, aluminum, and other ions (*1, 2, 3*). How well the caustic sludge is settled, washed, and filtered is desirable information for proper causticizing and lime kiln operations. High sodium content in the clarifier sludge indicates poor settling of the sludge, which is unfortunately the result of high causticizing efficiencies and high liquor concentrations (*4*). Over 1% Na_2O content of the filter sludge indicates poor washing and filtering with a prospect of "ringing" the kiln.

The conductometric test for sodium in caustic sludge consists in principle of measuring the specific conductivity of a filtered supernatant solution of the sludge slurry. A Solu-Bridge RD-P4 instrument with a hard rubber cell CEL-4 of cell constant 2.0 is used. The well-mixed sludge slurry is weighed and made up to a definite volume. Readings of the filtered supernatant solutions are taken in micromhos. When these readings are projected on a curve representing specific conductivity of various sodium hydroxide solutions, of which the sodium content had been volumetrically determined, the sodium content of the sludge slurries can be extrapolated therefrom. The present paper will, among others, demonstrate the magnitude of the error involved in such a procedure by checking the actual sodium content of those solutions by means of the zinc uranyl acetate method. A nomograph can be used to find the sodium oxide content of the sludge based on the moisture-free weight of the slurry sample. The calculation for the nomograph is based on:

$$\% \ Na_2O = \frac{\text{Gram weight } Na_2O \times 100}{\text{moisture-free weight sludge}}$$

The Solu-Bridge RD-P4 instrument is a rugged apparatus, making use of a vacuum tube relay and the Wheatstone Bridge principle. Details can be found in the manual supplied by the manufacturer, the Industrial Instruments Inc., Jersey City, N J. The instrument reads from 400 to 7000 micromhos specific conductivity and is generally used for boiler water analysis solids. In view of this range the concentrations of the unknown solutions should not exceed 2.5% Na_2O (by weight) or less than 0.05% Na_2O (by weight). Should the first limit be exceeded, a dilution of the sample under test is indicated. The conductometric test has also been used for determination of the degree of washing of the kraft pulp, and found to be very satisfactory in this respect (*5*). The cell used must be stored submerged in distilled water when not in use. The cell constant should be calibrated approximately once a week by checking against a standard solution of KCl (0.745 gram KCl per liter of distilled water) which has a specific conductivity of 1225 micromhos at 18°C. Occasionally the cell should be cleaned with 15% HCl by submersion for 2 min. and subsequent recalibration on the following day. Eventually, it may be necessary to replatinize the electrodes. The factor used for (*5, 6*) the correction of the readings in micromhos is:

$$\text{Factor} = \frac{1225}{\text{actual reading for KCl}}$$

The data used for the establishment of a curve of specific conductivity versus grams Na_2O were obtained by using a standard sodium hydroxide solution diluted to various concentrations. These solutions of various concentrations of sodium hydroxide were tested for specific conductivity, and the readings recorded. As a check on the concentrations of the NaOH solutions, 10-ml. aliquots were titrated against $N/100$ HCl using phenolphthalein as the indicator. Table I contains the results which, if plotted as a graph, show an almost linear relationship.

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A. H. Putnam, West Virginia Pulp & Paper Co.

James Cameron, National Container Corp.

Table I

Solu-Bridge controller reading in micromhos at 18°C.	Grams Na_2O per 100 ml. solution
643	0.037
1094	0.074
1929	0.146
3675	0.293
5432	0.440

In order to establish a relationship between the specific conductivity of the filtered supernatant solution and the sodium content of the moisture-free sludge, a reliable standard method for sodium analysis was needed. It was decided to determine the sodium content of the oven-dry sludge by the zinc uranyl acetate method. A weighed sample of oven-dry caustic sludge was made into a slurry by adding distilled water. This slurry was acidified by adding dilute hydrochloric acid, and then made slightly alkaline with ammonium hydroxide, and the excess ammonia boiled off. The solution was filtered, cooled, and made up to volume in a 500-ml. volumetric flask. An aliquot (equivalent to 0.004 to 0.008 grams Na) was withdrawn from the flask and evaporated to dryness on a steam bath. Removal of the sulphate ion from the aliquot at this point of the analysis is desirable. The residue was cooled, and 15 ml. of zinc uranyl acetate reagent was added according to the procedure for this analysis (*7*) The oven-dry weight of the sludge is determined by weighing 40 grams of the well-mixed sludge slurry in an oven at 105°C. to constant weight (*3*).

In order to determine the magnitude of the possible error of the method, the supernatant liquor of a series of sludge samples were checked for Na_2O conductometrically as described above and the values for Na_2O in the corresponding sludge determined by the zinc uranyl acetate method. These conductometric values were projected on the reference curve and the corresponding volumetrically determined Na_2O values noted. The volumetric values from the reference curve were then compared to the gravimetric values obtained by the zinc uranyl acetate method. Both Na_2O values were expressed in per cent of the dry sludge and their difference considered as the error of the method, the zinc uranyl acetate value serving as the reference value. The results are presented in Tables II and III.

From the tables presented it can be seen that the relative error range is from +2.00 to −1.7% for the clarifier sludge and from +15.4 to −14.3% for the filter sludge. It is probably due to variations in the conductivity of the cell itself and to the influence of other salts present.

CONCLUSION

From the results and observations presented, it can be seen that the application of the conductometric method to routine sodium analysis of caustic sludge is one that will secure reliable results for (1) clarification control of white liquor, and (2) washing and filtering control of the sludge before it enters the lime kiln. It is a fairly short test, requiring only 20 to 30 min., and does not require particular training.

Table II. Per Cent Na_2O in the Clarifier Sludge

Sample no.	Zinc uranyl acetate method dry sludge	Micromhos vs. g. Na_2O graph method	Relative error, %
1	15.6	15.6	±0
2	10.5	10.4	−0.94
3	10.3	10.4	+0.97
4	10.6	10.7	+0.94
5	10.5	10.4	−0.95
6	13.4	13.2	−1.49
7	14.3	14.2	−0.70
8	10.8	10.9	+0.93
9	10.5	10.6	+0.95
10	12.0	11.9	−0.84
11	11.5	11.3	−1.74
12	12.0	11.8	−1.67
13	12.0	12.0	±0
14	10.0	10.2	+2.00

Table III. Per Cent Na_2O in the Filter Sludge

Sample no.	Zinc uranyl acetate method dry sludge	Micromhos vs. g. Na_2O graph method	Relative error, %
1	0.40	0.40	± 0
2	0.23	0.22	− 4.35
3	0.27	0.27	± 0
4	0.18	0.17	− 5.56
5	0.23	0.25	+ 8.70
6	0.24	0.25	+ 4.17
7	0.22	0.23	+ 4.55
8	0.28	0.28	± 0
9	0.14	0.12	−14.29
10	0.20	0.19	− 5.00
11	0.20	0.20	± 0
12	0.08	0.09	+12.50
13	0.25	0.25	± 0
14	0.13	0.15	+15.38

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PRESENTED at the meeting of the Southeastern Section of TAPPI, Savannah, Ga., Sept. 30, 1955.

The Development of Curricula in Pulp and Paper Technology

C. E. Libby

THE Bureau of the Census is authority for the statistic that the paper industry is now the fifth ranking manufacturing industry in the United States. In value of its shipments it is surpassed only by motor vehicles, meat packing, steel works, and petroleum refining. Perhaps you may be as surprised as I was to learn that the dollar value of our relatively light and flimsy product exceeds those industrial giants like lumber manufacture, radio and television, chemicals, rubber, and textiles! If any of these statements are in error I want to confess that I have not taken the trouble of verifying the data from which the government expert I am quoting drew his conclusions. Having lost annual debates with government experts on March 4 every year, I have finally learned the hard way that they cannot be wrong!

Notwithstanding the fact that the paper industry is one of our biggest industrial enterprises, the educational facilities which have been established to serve its activities are probably the smallest and scarcest of those for any major industry. A survey conducted in 1954 by one of the universities offering instruction in papermaking disclosed that there were at that time 10 institutions with divisions or departments of papermaking and having a total undergraduate and graduate student enrollment of 400 men. Seniors and graduate students who were expecting to finish that year and become available

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for employment in the paper industry totaled approximately 150 men. An earlier survey conducted as long ago as 1920 by the American Paper and Pulp Association indicated that the American pulp and paper industry needed and could profitably employ at that time approximately 1000 specially trained college men each year. The paper industry in 1920

Kilgore Hall, home of the School of Forestry at North Carolina State College. This building completed in 1953 at a cost of $850,000 will continue to be used by pulp and paper students for their courses in general forestry, wood technology and fiber chemistry

had an annual productive capacity of approximately 7 million tons. In 1954 it produced nearly 27 million tons or almost four times the 1920 production. If its trained manpower requirements have increased in the same proportion as its productive capacity, then it should require, according to the 1920 estimate, about 4000 technically trained men each year. How closely these projections approximate the actual trained manpower requirements of the pulp and paper industry is anybody's guess. If they even approach reality the enormous gap between the presently available supply of 150 graduates and the calculated potential demand of 4000 graduates is a serious and growing threat to the continued expansion and technical progress of our industry.

While I am well aware of the cold cliche that "comparisons are odious," I cannot refrain from referring briefly to that other great American enterprise, the textile industry, and draw attention to the fact that it has provided itself with educational and research facilities far beyond anything even dreamed about for the paper industry. Perhaps I am especially conscious of the educational facilities available to the textile industry for the reason that my office window at State College looks out over the Nelson Textile School, a plant with an investment of approximately $2^1/_2$ millions of dollars in building and equipment, a student enrollment of over 500 men and women, and a sponsored research program underway for the members of its textile foundation to the extent of $350,000 annually. Furthermore, this school is not the biggest in the textile field according to a report which I unearthed last week in the plush air-conditioned Burlington Mills library of the Nelson Textile School, but has two rivals that are even larger. Altogether 10 textile schools that are members of the National Council for Textile Education had a total enrollment in 1951 of 4500 students and turned out over 800 graduates. Today, these figures are undoubtedly even higher. In addition, numerous smaller textile schools and colleges swell the ranks of textile graduates to well over 1000 persons annually. The paper industry could learn a valuable lesson from an intensive study of the educational and development programs of its little sister—the textile industry.

There is a long-standing controversy concerning the advantages of a highly specialized industrial training course at the undergraduate college level, typified by the textile schools which have just been described. Some employers feel that their technical manpower requirements are best satisfied by the employment of a chemist or engineer and training him in their own organization in the processes and techniques peculiar to their operations. On the other hand, there is a conviction on the part of many paper mill executives that the young technical graduate who possesses a good fundamental knowledge of their raw materials and at least a theoretical understanding of their processes is a better employment risk than the graduate who is wholly unfamiliar with their operations. The case for this group of employers, might be briefly summarized as follows:

1. Cellulose, the principal raw material of the industry is a chemical compound more complex even than petroleum or rubber. A basic knowledge of its physical and chemical properties, the best methods for its isolation and purification, and the possibilities for mechanical and chemical conversion is invaluable in research and encompasses a sphere of knowledge seldom acquired by the general chemical or engineering graduate.

2. It is the opinion of many paper mill executives that the graduates of a well-organized school of papermaking, operating with a properly designed and balanced curriculum, have a competence immediately following graduation equal to that of a nonspecialized graduate after 2 to 3 years of work experience. Concrete evidence of this belief was exhibited at the end of the past school year when salary offers to the few graduates of our own papermaking curriculum at State College averaged $1000 more annually than the offers to general engineering graduates. In all cases these unusually high salary offers came from mills where paper school graduates had been employed for many years.

3. Perhaps the best argument in favor of the undergraduate school of papermaking is the fact that the graduates of these schools realize that they are best fitted for work in the paper industry and almost invariably seek employment in some phase of this industry immediately following graduation. In general, graduating engineers do not favor papermaking as a field of employment. Of 206 engineering graduates at North Carolina State College in June, 1955, only two took jobs in the paper industry. Absolutely none of the 15 chemical engineering graduates accepted paper mill employment notwithstanding numerous interviews with personnel representatives of some of the best companies in the field.

4. Still another important factor in favor of the paper school graduate is the fact that, in general, he remains with the industry throughout his business career. A survey conducted by a northern university indicated that 92% of its papermaking graduates were still employed with their industry 10 years after graduation, while only 50% of the graduates of this institution's other divisions still remained in the fields of work for which they had been trained.

Now having successfully disposed of the argument that paper schools are not justified, at least disposed of successfully so far as I personally am concerned, let us proceed to that heresy concerning the folly of establishing a curriculum in papermaking at a school of forestry. I must confess to a feeling of being somewhat in the middle on this argument for, as some of you know, I am not a forester, having been trained as a chemical engineer and was first employed in the industry in this capacity. Through some quirk of fate I finally found myself helping to organize the first department of papermaking ever established in this country as an integral part of a college of forestry. Many individuals had a hand in this venture and any favorable recognition that this school has received may be attributed primarily to the vision of its first administrator, Dean Hugh P. Baker, later executive secretary of the American Paper and Pulp Association.

Secondly, the credit should go to the hard work and cooperation of an enthusiastic and competent faculty, most of whom are still active in the paper industry today. Measured by the demands for its graduates and their rapid rise to positions of reponsibility in the industry, it would be difficult to prove

New pulp and paper laboratory building now under construction at North Carolina State College at a cost of $225,000. When fully equipped this building will represent an investment of nearly $500,000. It will house offices, classrooms, and laboratories for the pulp and paper staff and students. Expected date of completion is February, 1956

that this pioneer experiment in forestry education for the paper industry was not a success.

There is no argument with the fact that the unmodified orthodox forestry college curriculum is unsuited to the proper training of a pulp and paper technologist. Such curricula are almost universally loaded too heavily with biological sciences and, in addition, are too deficient in physical science to serve as a suitable foundation for the required courses in chemistry and engineering that must be included in any properly designed curriculum in pulp and paper technology. On the other hand, the orientation course in general forestry and the work in botany serves to introduce the student to wood, the dominant raw material of the industry and gives him an insight into forest management and wood procurement and in our opinion is a feature so desirable that papermaking curricula in engineering colleges ought to make it a requirement of their programs in those institutions where forestry curricula are also available. Forestry courses in wood technology, like those in wood structure and fiber identification, are directly applicable to the work of the paper chemist and are of great value to him if he is skilled in their use.

I believe that everyone in this audience is aware that we have inaugurated a new curriculum in pulp and paper technology at North Carolina State College, which is sponsored by the School of Forestry. The program of courses conforms pretty closely to those which may be found in any curriculum in this field with minor emphasis of course on those subjects essential to forestry education. A detailed verbal description of this curriculum, is given below.

Freshman Year in All Forestry Curricula

Courses	Terms and credits Fall	Spring
General botany	3	3
Inorganic chemistry	4	4
Composition	3	3
Introduction to forestry	2	2
Algebra, trig., anal., calculus	4	4
Mil. science or air science	2	2
Physical education and hygiene	1	1
	19	19

Curriculum in Pulp and Paper Technology

Sophomore Year

Courses	Terms and credits Fall	Spring
Chemistry, analytical	4	0
Basic speaking skills	0	3
Scientific writing	0	3
Wood structure & properties	3	0
Analytical geometry & calculus	3	3
Engineering drawing	2	2
General physics	4	4
General psychology	0	3
Mil. science or air science	2	2
Physical education and hygiene	1	1
	19	21

Summer

Forestry problems—mill experience	3

Junior Year

Courses	Terms and credits Fall	Spring
Elements of chemical engineering	3	3
Chemistry, organic	3	3
Chemistry, physical	3	3
Electrical applications in wood products	0	3
Pulp and paper technology	3	3
Advanced wood structure & ident.	2	0
Fiber analysis	0	2
Fundamentals of heat, power	3	0
Electives	2	2
	19	19

Senior Year

Courses	Terms and credits Fall	Spring
Economics, general	3	0
Paper technology lab.	0	2
Pulp & paper mill equipment	3	2
Paper testing lab.	2	0
Paper coloring lab.	0	2
Paper converting	1	0
Plant inspections	0	1
Pulp technology, lab.	4	0
Pulp & paper mill management	0	2
Research problem	1	3
Cellulose chemistry	2	0
Social science elective	0	3
General electives	3	4
	19	19

This program is new and is still more or less in a state of flux. We know that it can be strengthened in several areas and we intend to make changes as conditions permit. One change in which I am personally very much interested is the addition of a fifth year to the undergraduate program in which a student may broaden his training by adding one of several available options, e.g., in production management, in personnel management, or in merchandising, etc. In addition, it is our intention to add a graduate program at the master's level just as quickly as our laboratory facilities will permit us to accommodate graduate students. The services of graduate students are practically indispensable in assisting with the supervision of undergraduate laboratory work and graduate research provides a normal outlet for the abilities of the superior student as well as the productiveness of the natural teacher.

This paper would be incomplete without mention of the splendid cooperation which we have received at North Carolina State College from the southern paper industry in the establishment of this new paper school. This cooperation culminated this year in the formation of a Pulp and Paper Foundation which is currently being supported by 19 paper mills and 38 mill supply organizations. Funds donated by these organizations have been used in establishing 16 scholarships, 10 being in the amount of $600 per year for 4 years while the remainder are for $300 each. These scholarships have enabled the college to recruit an outstanding freshman

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J. E. Ayer, University of Alabama

class of 31 young men majoring in pulp and paper technology. It is expected that this program will be continued for a number of years, and if this hope is realized then State College will eventually be in a position to provide considerable assistance in alleviating the current critical shortage of technical personnel in our rapidly expanding southern paper industry.

PRESENTED at the meeting of the Southeastern Section of TAPPI, Savannah, Ga., Sept. 30, 1955.

Pacific

The seminar held by the Pacific Section of TAPPI was held at the Research Laboratory of Crown Zellerbach Corp. in Camas, Wash., on Sept. 22 and 23, and at Bagley Hall, University of Washington, Sept. 27 and 28. The speaker was George Jayme, director of the Institute of Cellulose Chemistry, Technical University, Darmstadt, Germany. The subject of the seminar was the physical and chemical properties of fibers in relation to their use in production of paper and artificial fibers.

Mr. Jayme first discussed the morphological factors such as fiber length, cell wall thickness, and cross-sectional shape. He pointed out the manner in which variations in these properties will affect the properties of the resulting paper. He then spoke on the matter in which the different constituents are distributed within fibers and within the wood and also the changes in the degree of polymerization of cellulose during the pulping operation. Some laboratory work on the influence of hemicelluloses was also presented.

One of the most interesting items concerned the determination of the water retention value of pulps by a centrifuging method. The method described is quite simple and fast and will indicate the amount of refining which a pulp has received more clearly and more definitely than will the use of freeness tests.

During the second day, Mr. Jayme spoke about the re activity of pulp and wood towards xanthation and acetylation and the properties required in a dissolving pulp in order to give sufficiently clear solutions or films. The final session was devoted largely to slides concerning the optical detection of fiber irregularities in sulphite pulping. The electron photomicrographs were especially interesting because they showed the cell wall structure more clearly than any previous pictures have done. ROBERT SMYTHE, *Secretary-Treasurer*

Maine-New Hampshire

The Maine-New Hampshire Section of TAPPI held its fall meeting on October 28–29 at the Lafayette Hotel in Portland. Features of particular interest were the two technical sessions on "The Use of Soft and Hardwood Bleached Kraft in Paper," and presentation of the Second Worthen Brawn Awards.

Technical Session

Following registration on Friday, A. E. Jones, chairman of the section, welcomed the delegates and introduced R. J. Martin, vice-chairman in charge of the technical program. Mr. Martin introduced the first speaker, Maurice Blew, Strathmore Paper Co., who spoke on "What the Fine Paper Mill as Distinguished from Others Wants from Bleached Kraft Pulp."

Mr. Blew stated that the fine paper mill expects high strength, cleanliness and moderately high brightness from bleached kraft pulp. High strength has been the distinguishing characteristics of kraft for many years and its use in certain grades is mandatory, particularly those requiring high tear and fold. Cleanliness has improved to a great extent but only a few mills have maintained a consistently high degree of uniformity in this respect. Brightness levels of various pulps vary widely and possibly the range could be reduced.

The second paper, "The Use of Bleached Kraft Pulp in Tissue," was presented by L. R. Adkins, Waterfalls Tissue Corp.

Mr. Adkins expressed that kraft pulps impart a harsh "raggy" feel which is not acceptable in sheets where extreme softness is required. The goal is for a pulp with the strength of kraft and the softness of sulfite. Generally speaking, a satisfactory pulp should brush out with a minimum of hydration and develop strength at a high rate initially. The ultimate strength is of no interest since softness could not be retained.

Fiber length distribution is also an important factor since long fibers tend to give poor formation under the conditions of minimum refining and fines have low retention and lead to surface fuzz.

Brightness is important in high grade facial type papers. Kraft pulps are still, for the most part, not so bright as sulphite.

In conclusion, Mr. Adkins stated that improvements in kraft pulp, to attract manufacturers of facial grades, must include greater softness, lower cost, and better color.

The third paper entitled "Testing of Bleached Kraft Pulps for Heavy Duty Papers" was presented by W. L. Hearn, Brown Co. Mr. Hearn stressed the importance of knowing the pulp characteristics prior to use. From the papermakers view, these would include: (1) brightness and cleanliness, (2) good combination of strength and tear resistance, and (3) good sheet forming properties with reasonable power requirements for refining.

It has been found that the ball-mill, the mill size fly-bar-beater and the stone roll beater tend to more nearly approximate each other as contrasted to the Valley beater in the evaluation of strength characteristics.

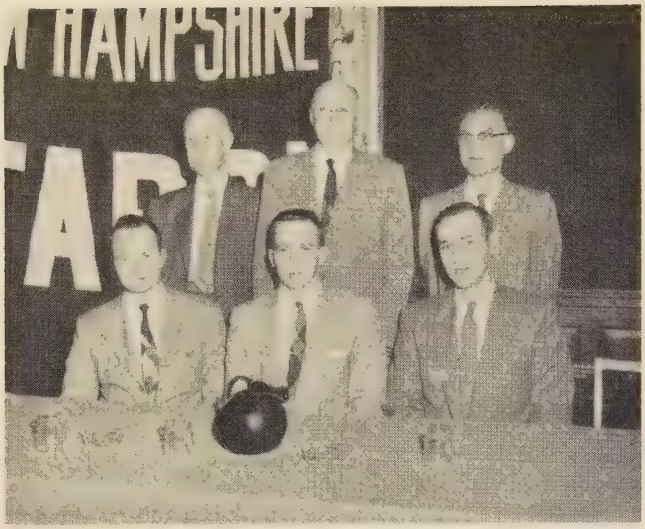
Another relationship of interest is that of the C.E.D. viscosity and beater value (twice the burst plus tear value). This comparison is fairly consistent for the same types of pulp processed from similar wood species and under standardized cooking and bleaching methods. Pulps of high C.E.D. values are desired for heavy duty papers.

In conclusion, Mr. Hearn stated that mill studies, coupled with laboratory tests, can go far in quality and process improvement in the paper mill.

Worthen Brawn Memorial Award

Following the presentation of the papers, Chairman Jones announced the Worthen Brawn Memorial Award competition, stressing its importance in encouraging the younger technical men and engineers to participate in the many and varied scientific activities of the industry. He urged all delegates to stimulate interest on the part of their mill personnel in this program. Papers for the 1956 award should be submitted before August 15.

Chairman Jones then introduced the judging committee,



Worthen Brawn judges and contestants (back, left to right): E. Sutermeister, J. L. Parsons, and T. H. Geiger; (Front, left to right): L. E. Robinson, R. C. Chase, and D. S. Edgerton

comprised of J. L. Parsons, E. S. Sutermeister, and T. H. Geiger. Mr. Parsons gave a brief résumé of the life of Worthen Brawn and introduced the winner, Dan E. Edgerton of the Rogers Fiber Co. Mr. Edgerton read his paper, entitled "An Evaluation of a Grid Technique for the Determination of Fiber Length Distribution in Chemical Pulps."

He said that the currently popular techniques for determining fiber length are generally too slow and tedious for satisfactory use in control. He has investigated a comparatively rapid method employing a blade grid on the British sheet machine according to a procedure developed by deMontigny and Zborowski. He concluded that a definite correlation exists between the fiber retained on the grid and the length distribution for specific pulps and that the method exhibits good possibilities of becoming a useful tool for the control of stock preparation.

The runner-up was R. C. Chase of the University of Maine. Mr. Chase read his paper entitled "The Development of a Photographic and Electronic Technique for Determining Pulp Velocity in a Rotating Cup Viscosimeter."

An instrument developed at the University used to predict the friction loss in a pipe line has been refined by providing means for determining the stock velocity photographically. An electronic timing device marks the portions of stock and photographs them at two known intervals. From this information the rate of shear may be calculated. Future possibilities of this apparatus, in addition to its use in stock handling problems, include the determination of type of flow existing at various intervals.

Mr. Sutermeister complimented the participants on their fine contributions and presented, to the winners, the awards, and to all contestants, an autographed copy of his book entitled "Chemistry of Pulp and Paper Making." The contestants had been given membership in the Maine-New Hampshire Section.

The session then adjourned.

Evening Banquet

At the Friday night banquet, Chairman Jones welcomed members and guests, reminding them that this year marks the 10th anniversary of the receipt of the Maine-New Hampshire Charter. He introduced W. D. Harrison, vice-president of National TAPPI who brought greetings from the National organization and praised the section for its success. Mr. Clifford Patch gave a brief summary of the original organization of the Maine-New Hampshire Section.

Dancing completed the evening activities.

Panel Discussions

Following a group breakfast on Saturday morning, a panel discussion was held with Paul Goodloe acting as moderator. Members were: Maurice Blew, L. R. Adkins, W. L. Hearn, and W. V. Torrey (S. D. Warren). There was an active discussion on the outlook for sulphate pulps and on various phases of pulp testing. It was felt that while kraft pulp has shown a phenomenal growth, sulphite has certain properties, outside of cost, which favor its use in many existing grades of paper. In the evaluation of pulp, there apparently is a great diversity of methods employed in the various mills and the indications are that considerable improvements are possible in this field.

The meeting was then adjourned.

Meeting committees and chairmen were:

General Chairman: A. E. Jones, Oxford Paper Co.
Technical Program: R. J. Martin, Chairman, Fraser Paper Ltd., J. H. Heuer, Great Northern Paper Co., Dr. Paul M. Goodloe, Brown Co.
Local Arrangements: Jack Fife Wright, Chairman, National Aniline Div., B. A. Taylor, James A. Taylor & Son, H. E. Pratt, Pejepscot Paper Div.
Public Relations: E. N. Poor, Hudson Pulp & Paper Corp.
Educational: Clifford Patch—Chairman, C. T. Bockus, Eastern Corp., A. J. Chase, University of Maine
Routine Control Methods: H. S. Hooper, Penobscot Chemical Fibre, F. N. Sprague, St. Regis Paper Co., A. E. Bachmann, Missisquoi Corp.
Judges for Worthen E. Brawn Award: J. L. Parsons, Waterville, Me., E. S. Sutermeister, Westbrook, Me., T. H. Geiger, Oxford Paper Co.

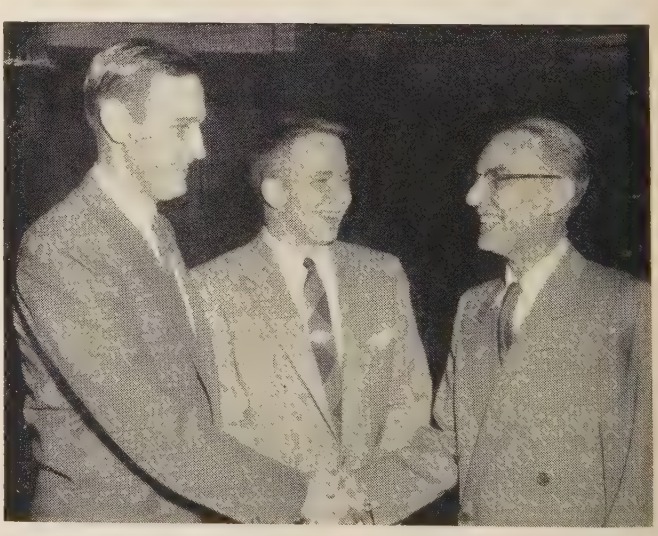
E. N. Poor

Bleached Kraft Pulp for Dry Creped Tissue

L. R. Adkins

Facial tissue and the various facial grades have traditionally been made from sulphite pulps, sometimes combined with soda pulp or groundwood. Notable exceptions are, of course, to be found in those mills where some grades of wastepaper are used. However, while it is true that there are a few high quality tissues made which contain waste, this material is, for the most part, confined to those cases where price is the primary consideration and quality of secondary importance.

L. R. Adkins, Waterfalls Tissue Corp., Mechanic Falls, Me.



Worthen Brawn winners (left to right): Dan E. Edgerton, R. C. Chase, and T. H. Geiger (member Judging Committee)

Within the past 2 years, we, at Waterfalls, have been using kraft pulps in some grades of tissue. This use is still confined to those grades where strength is of prime importance and extreme softness is not necessary.

This brings us to the main drawback to the use of kraft in facial tissue. It imparts a harsh "raggy" feel to the sheet which cannot be tolerated in a top quality facial sheet. What we want, of course, is the strength of kraft combined with the softness of sulfite.

Generally speaking, we look for a pulp which will brush out with a minimum of hydration and develop acceptable strength with no loss of softness. Such a pulp will have a comparatively flat freeness curve and at least a moderately steep strength development curve as plotted against beating time.

At least, the initial curve should be steep. Pulps of very high ultimate strength are of no particular interest to us, since we cannot possibly beat long enough to develop this strength and still retain softness. In mill operation, our furnishes are ready for the machine before we have developed more than 25% of the increase which is theoretically possible over that of the unbeaten pulp. Many times, we must be satisfied with a lower figure, because of the hardening effect of the rapid hydration which accompanies strength development on many pulps.

At the same time, the fiber itself must remain soft and pliable. A stiff fiber in the body of the sheet will give the "raggy" feel previously mentioned. Moreover, crepeing a sheet at low moisture content partially frees a considerable percentage of the fibers from the mat and leaves the ends sticking up out of the surface of the sheet. If the fibers are stiff or "brash," the sheet will have a harsh, scratchy feel. If the fibers are soft and pliable, the sheet will feel soft and velvety.

This softness is a characteristic of most sulphite pulps which has, until comparatively recent times, been completely lacking in kraft fiber. In the past year or two some sulphate pulps have become available which approach the fiber softness of sulphite. It is these pulps with which we have been working at Waterfalls.

On facial grades, we actually depend on what might be called fiber entanglement in the sheet rather than bonding of fiber to fiber, to secure whatever strength we can get. To this end, refining becomes a matter of brushing out and working the fibers to ensure a uniform, well closed sheet. A pulp which will stand this treatment with a minimum of hydration has one of the important characteristics of a good facial grade pulp.

An indication of this characteristic can, perhaps, be found in the tear curve of pulps put through the comparatively gentle laboratory beating test which we use at Waterfalls. For a pulp which will make a satisfactory facial tissue, the curve of tear plotted against freeness will rise over all, or nearly all of that portion which represents the mill operation range.

Friday speakers (left to right): W. L. Hearn, Maurice Blew, R. J. Martin-Chairman, and L. R. Adkins

Panel (left to right): Paul Goodloe, W. L. Hearn, W. V. Torrey, Maurice Blew, and L. R. Adkins

The next important consideration in selecting a pulp for facial tissue is fiber length distribution. Very long fibers cannot be tamed by the amount of beating which we can give a furnish. Consequently, a very long fibered pulp tends to make a wild cloudy, weak sheet with a high proportion of wide open spaces. On the other hand, a high percentage of fines is even more objectionable. A $7\frac{1}{2}$ to 8-lb. wet web of free stock forms very quickly and makes a poor mat for holding fines. Consequently, a fairly high proportion of the fines which flow under the slice, end up in the wire tray. Those fines which stay with the sheet leaving the wire, are loosened and dragged from the dry web at the crepeing doctor as paper dust. This dust which may fly around the machine room, collect on the converting machines or go into the finished package, is one of the most troublesome problems in the plant. A Bauer-McNett classification of a good facial grade pulp will show 40 to 50% retained on a 20-mesh screen; about 65% retained on a 35-mesh screen; 75 to 80% on 65-mesh; around 90% on 150 mesh and not over 10 or 12% fines.

This brings us to consideration of pulp brightness. While it is true that all facial tissue is not of the highest brightness it is still a fact that this quality is a very important selling point for top quality tissue. Moreover, when we make grades which can run lower in brightness, a high brightness base stock allows the use of significant amounts of unbleached or semibleached chemical pulps or groundwood. Since lower brightness sheets are generally lower priced sheets, some blending with lower cost pulps is an absolute necessity to meet furnish cost limitations. For this reason, a high brightness base stock may well be the factor which makes a low brightness sheet profitable.

The brightness of bleached kraft pulps has, until comparatively recently, been such as to leave much to be desired. The kraft pulps which we have been using show considerably better brightness than was available a few years ago. This improvement is an important factor in making possible their use in facial grades. While this brightness improvement is impressive, the bleached krafts are still, for the most part, not so bright as bleached sulphite. There must, therefore be continued improvement in this direction if bleached kraft is to become fully competitive with sulphite for facial grades.

You are all well aware that the cost of the pulp represents a major part of the cost of the finished sheet. Every extra

Banquet (left to right): A. E. Jones, W. D. Harrison, Mrs. Thomas, J. J. Thomas, Mrs. Wright, J. F. Wright, H. E. Pratt, A. J. Chase, and R. J. Martin

dollar of furnish cost must be subtracted from profit and must result in some definite improvement if it is to be justified.

At the moment, it looks as though the cost of bleached sulphite may catch up with that of bleached kraft. However, the kraft has, traditionally, been the more expensive pulp. In recent years, this premium in price has amounted to from $7.50 to $10.00 per ton. On this basis, its use has been out of the question in our regular tissues. Only when it could contribute some unique characteristic, have we felt justified in putting it into the sheet. If any substantial tonnage of bleached kraft is to be used in facial grades then, generally speaking, its cost must be made competitive with that of bleached sulphite.

It is only in comparatively recent times that we have been able to consider the use of bleached kraft pulps in facial grades. This is due, in part, to improvements in our own manufacturing techniques and, in part, to the very substantial improvement in the bleached kraft available. No doubt we will further improve our manufacturing methods in the future. However, I doubt very much that we will develop any practical method by which we can better the brightness or fiber softness of a pulp beyond what we receive from the pulp mill. Further advances or improvements in bleached kraft pulp quality are a foregone conclusion. Such advances, to attract the manufacturers of facial grades, should first, improve fiber softness; second, lower pulp cost; and third, increase brightness. This, of course, must be brought about without losing the present advantage of better strength, and keeping in mind the other qualities which we must have.

PRESENTED at the fall meeting of the Maine-New Hampshire Section of TAPPI, Portland, Me., Oct. 28–29, 1955.

Testing of Bleached Kraft Pulps for Heavy Duty Papers

W. L. Hearn

PRIOR to 1928, fully-bleached softwood kraft pulps having physical characteristics approaching those of unbleached kraft, were unknown in the market. In that year, however, after extensive laboratory study, Brown Corp. at La Tuque, Que., produced commercially such a pulp, having a brightness equivalent to commercial bleached sulphites of that time.

With the introduction of the new pulp, it became necessary to find uses to which paper made from bleached kraft could be used to advantage. The paper-bag field was singled out as a natural. Sulphite bags were limited in inherent strength

W. L. HEARN, Technical Assistant to Manager, Paper Manufacturing Div. Brown Co., Berlin, N. H.

Table I. Comparison of Beating Methods at 10% Shrinkage

	Ball Mill	*Valley*	*Flybar*	*Stone roll*
Unbleached kraft				
Beating time, min.	40	58	233	102
Canadian freeness	590	315	465	450
Burst	149	191	133	137
Tear	270	236	280	310
Beater value	568	618	546	584
Fold schopper	2200	3650	2550	2100
Absorbency ins.—10 min.	0.85	0.42	0.85	0.70
Bleached kraft				
Beating time, min.	52	45	148	64
Canadian freeness	600	390	530	520
Burst	150	190	137	148
Tear	305	250	310	312
Beater value	605	640	584	608
Fold schopper	2500	3300	2400	2450
Absorbency ins.—10 min.	1.20	0.55	1.20	1.20

and as a result of the introduction of the improved pulp, stronger white paper bags gave impetus to changes in packaging of many food products. Other grades such as spinning, waxing, gumming, as well as bond, ledger, and later wet-strength and sanitary grades were greatly improved by the use of bleached kraft pulps in place of bleached sulphite.

Since World War II, chlorine dioxide has been widely used to produce bleached kraft pulps with brightness of 90% and which retained the strength features of 80 to 85% brightness grades produced prior to its use. Paper made from such pulps is being demanded by paper users because of the increased attractiveness of the finished product. Brown Co.'s new kraft bleachery at Berlin will take maximum advantage of chlorine dioxide, which will be produced by the company's own electrolytic cycling process.

To the pulp user, the question of pulp testing and the relationship of paper tests is one of great importance. Numerous methods of physical testing have been proposed and used, but there is a wide scope left for the scrutiny of the importance of the tests made on paper and, consequently, on pulps such as kraft pulp, relative to the actual end use requirement. Frequently too much stress is put on a test which is of minor importance, thereby interfering with the obtaining of more important characteristics in the paper and causing the pulp and papermaker unnecessary difficulties in meeting these specifications which are of minor importance.

In general the methods consist of the following steps: (1) sampling, (2) sample preparation, (3) beating, (4) sheet-making, and (5) testing of handsheets. It is important in

Banquet head table (left to right): Paul Goodloe, H. S. Hooper, Mrs. Hooper, E. N. Poor, Mrs. Poor, Clifford Patch, Mrs. Jones, and A. E. Jones

Table II. Ball Mill Beaten Pulp Tests of Various Kraft Base Pulps with C.E.D. Viscosity and Brightness Values

	Beating time. min.	Freeness	Shrinkage	Strength	Tear	Beater value	Brightness	C.E.D.
Regular bl. kraft	60	460	13.7	153	254	560	86	54.0
ClO_2 bl. kraft	60	460	12.5	150	285	585	90	100 0
West Coast bl. kraft	60	515	10.9	126	320	572	81	45.8
Southern bl. kraft	60	440	16.1	126	248	500	85	35.1
Swedish bl. kraft	60	430	14.2	144	270	558	90	75.4

setting up a procedure that conditions of each step be as closely controlled as possible.

The necessity of proper sampling and sample preparation is almost axiomatic. Sample preparation will vary as to dryness of the pulp and the method of beating employed. The manner of beating is a matter of choice; the writer's choice being the ball mill. Sheetmaking should be such that uniform sheets are formed, carefully pressed, dried under standard conditions, and humidified prior to testing.

The description of the procedure as used at the Brown Co. has been published (*1*, *2*).

Papermakers are prone to blame pulp for certain deficiencies in paper quality and at times they are correct. However, to properly safeguard paper quality, it is important to know the pulp characteristics prior to its use in the paper mill. What pulp characteristics are most important from the papermaker's point of view? He would doubtless list the following: (1) brightness and cleanliness, (2) good combination of strength and tear resistance, and (3) good sheet forming qualities with reasonable power requirements for beating

Comparative tests of pulps beaten in the ball mill, Valley beater, mill size fly-bar beater, and the stone-roll beater were undertaken some years ago. It was found that comparing endurance pulp beating tests at beating times to give 10% area shrinkage, the ball mill, the mill size fly-bar beater, and stone-roll beater tend to more nearly approximate each other as contrasted to the Valley beater—the latter giving lower tear, higher burst and higher folding endurance. By plotting physical tests of endurance beaten pulp against shrinkage in area, it was found that at 10% shrinkage, approximately maximum fold and beater values are reached. This value of shrinkage was also selected as it corresponded quite closely to that of mill beaten stocks of many normal paper grades.

Table I illustrates the comparison of beating equipment used and indicates that the ball mill more nearly approximates the fly-bar and stone-roll beater at 10% shrinkage than does the Valley.

Another relationship of interest is that of C.E.D. viscosity and beater value (*3*, *4*). Beater value is an arbitrary figure obtained by multiplying the mullen by two and adding the tear values.

Table II illustrates ball mill beating tests at one beating time of various grades of bleached sulphate together with the C.E.D. viscosity and beater value of each individual pulp. It is indicated that pulps of high C.E.D. values are to be desired for heavy duty papers where a combination of high tear and burst is required.

A study of mill beating equipment and its effect on stock tests is also of importance. Handsheets made from pulp after individual refining steps or from individual beaters can readily point out what is going on. Mill studies together with laboratory tests of pulps can go far in quality and process improvement in the paper mill.

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Presented at the fall meeting of The Maine-New Hampshire Section of TAPPI, Portland, Me., Oct. 28–29, 1955.

Acknowledgment is given to D. H. McMurtrie and H. R. Titus of the Brown Co. Research Department for data used in this paper.

Delaware Valley

On Sept. 29, 1955, the Delaware Valley Section of TAPPI opened its 1955–56 year. The meeting was divided into an afternoon and evening session. Attending the afternoon session were 140 members and 165 members at the evening session.

The afternoon session was an excellent and well planned trip through the National Vulcanized Fibre Co.'s plant and their new, fine, advanced research and development laboratories.

The evening session was held at the du Pont Co.'s country club at Wilmington, Del. The evening was divided into a social hour, dinner, short business meeting, and a talk on beta gage control by J. A. Van den Akker of The Institute of Paper Chemistry. Following Mr. Van den Akker's talk, a question-answer and discussion period was held.

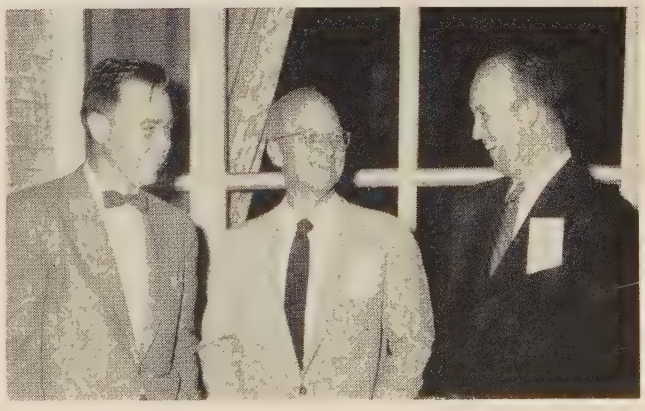
Beta-Ray Gage Control of Basis Weight—Abstract

J. A. Van den Akker

The fundamentals of radioactivity which are essential to an understanding of gaging by means of beta radiation were discussed. This included qualitative descriptions of alpha, beta, and gamma radiations, their approximate ranges in matter, and the modes of absorption and scattering. Naturally occurring and artificially produced radioactive isotopes were discussed, the elementary law of decay of radioactivity with time was explained, and useful concepts such as "half life" were introduced. The way in which beta particles (fast negative electrons) pass through air, ionization of the air through encounters with the electron atmospheres of molecules, and scattering of the beta particles by these encounters were described. The ionization chamber, which is used in commercial beta-ray gages for measuring beam intensity, was described, in the forms used in instruments which operate on the principles of (1) transmission of electrons, and (2) back-scatter of electrons.

Reference to early work in the field (approximately 40 years ago) brought out the importance to the transmission-

J. A. Van den Akker, Research Associate, Institute of Paper Chemistry, Appleton, Wis.



Left to right: C. F. Ackerman, Union Mills Paper Mfg. Co.; J. A. Van den Akker, Institute of Paper Chemistry; C. R. Calkins, Riegel Paper Co.

basis weight relationship of weighted average atomic number of the substance through which beta-rays pass. This relationship is basic to the operation of all transmission-type beta-ray gages and an understanding of it on the part of the users of beta-ray gages is essential to the minimization of error attributable to varying chemical composition of the web under control. The interesting point was made that beta-ray gaging in the old days was a practical impossibility because of the short half life of naturally occurring radioactivity elements which were not also sources of gamma rays (a hazard to personnel). Beta-ray gaging is one of the many very valuable products of nuclear research, which has yielded such useful beta-ray sources as Sr^{90}, Ru^{106}, Cs^{137}, and Te^{204}, the essential characteristics of which were presented, along with the importance of information on the daughter products of these radioactive isotopes.

The talk brought out the advantages and disadvantages of back-scatter beta-ray gages.

A number of practical matters important to the reliable and accurate use of beta-ray gages in paper mills were discussed, such as calibration, sensitivity considerations, the potentially large effect of electrostatic charge in the paper web, the dependence of instrumental indication on frequency and voltage variations of the power line, drift effects, the influence of rate of variation of ambient temperature, passline variation, and the nature of statistical fluctuations in the radiation from the beta-ray source. Most of this discussion was based on findings reported to the American Paper and Pulp Association in instrumentation Report No. 46, Parts I–VI, incl., by The Institute of Paper Chemistry. (These reports, if not available in the mill library or files, may be obtained by writing to E. W. Tinker, American Paper and Pulp Association, 122 East 42nd St., New York 17, N. Y.).

Q. Is there any convenient way to eliminate static electricity before it gets into the beta gage?

A. There is no way to completely eliminate it. A static eliminator such as a wire or chain or, perhaps better still, a tinsel type of sheet contact upstream of the gage is about as helpful as anything.

Q. If the beta gage is placed at the wet end after the last press, will it be more effective in measuring the sheet's weight including the water?

A. It would not be a good location for the gage to measure basis weight. A gage located at the wet end along with one at the dry end would provide a good means for finding operating variations, however.

Q. Could an artificial source provide the stream of electrons?

A. Yes. Such a source would be more consistent and unidirectional.

Q. On several types of board, loaded and unloaded, coated and uncoated, would one calibration cover all?

A. No, only by accident. A calibration would be needed for each type against a well controlled process.

Q. On coated board can both the basis weight variation and coating variation be determined with the beta gage?

Left to right: P. E. Nethercut, Scott Paper Co., chairman, Delaware Valley Section; C. B. Harris, du Pont; and Howard H. Street, National Vulcanized Fibre Co., National President of Superintendent's Assn.

Al Green, National Vulcanized Fibre, describes printed circuits to visitors in National's new research and development laboratory

A. No. For the coating alone the back-scatter principle might fit in.

Q. Might we not get some type of control on a polyethylene extrusion?

A. No. Plastic atomic numbers are too near that of paper.

Q. Does air in the gap or control equipment effect temperature change?

A. Yes. It can be estimated from the gas laws. The absorption type of beta gages are very sensitive to space changes, one to two thousandths of an inch being disastrous.

Q. Would a roll out of round effect the back-scatter type of beta gage?

A. Not necessarily, as it is not sensitive to space setting.

Q. What do the instruments cost?

A. The prices range from the hundreds of dollars to thousands of dollars. One laboratory instrument sells for $5000; one scanning the machine in one spot $10,000; and traversing instruments $15,000 to $20,000.

Q. Are there any commercial installations that are considered a success?

A. St. Regis reports successful application on polyethylene extruder. Some have reported actual savings in dollars through beta gage control. There are difficulties other than static yet to be overcome, however.

Q. Would foreign elements, such as those introduced into the furnish by using river water, produce a variation in the beta gage?

A. If the particles were of sufficient weight they would show as a variation. Such particles we would not expect to be introduced by river water, however.

Q. With a scanner at the head box, could the principal variations across the web be determined?

A. Scanning across the web has been carried on successfully at the dry end; such scanners are very clostly.

Q. Will moisture in the sheet produce an error in the scanner?

A. The moisture effect can be determined by running the moisture profile along with the scanner's simultaneously. This can be accomplished by using a moisture meter or found by difference from the wet and dry sheet from the reel.

Q. How much variation in atomic number is there in board manufactured from waste paper?

A. Not definitely known. If, however, all the elements are known, it can be calculated by multiplying the atomic number of each element by its atomic weight, summing these calculations up and dividing this by the sum of the atomic weights.

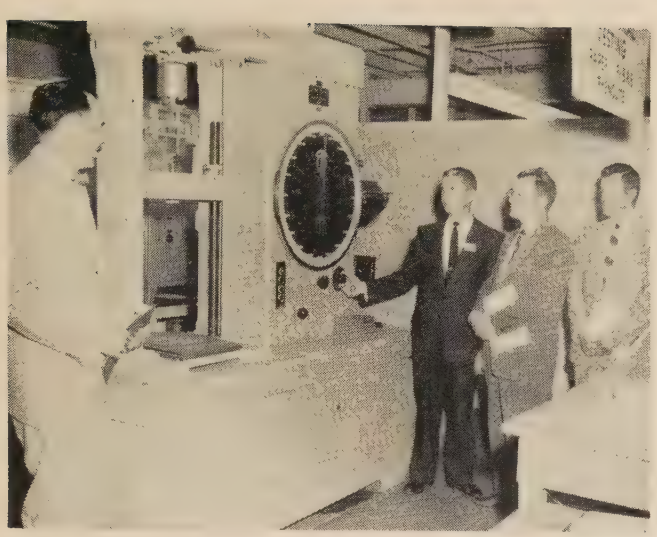
The Scott Paper Co. has found a laboratory beta gage very valuable to them in normal day-to-day control. The instrument they are using has a two-speed drive. It is being used to determine sheet levelness from 10-lb. facial to 32-lb. toweling. The drive in the cross machine direction is 24 in. per min. and 16 in. per min. in the machine direction. Test results are obtained in approximately 12 min., which is in time to inform the machine tender prior to the completion of the next set.

GEORGE K. BOGER, JR., *Secretary*

New England

On Oct. 7 and 8, 1955, the New England Section of TAPPI held a joint meeting with the Connecticut Valley Superintendents Div. of the American Pulp & Paper Mill Superintendents Association at the Curtis Hotel, Lenox, Mass. A total of about 300 members and guests were present.

Approximately 175 people attended the presentation of two



W. M. Shane, National Vulcanized Fibre, demonstrates operation of their Tinius-Olsen tester to visitors in National's research and development labs

technical papers. The technical session consisted of two papers, the first being, "Surface Sizing Resins—A Progress Report," by Elmer H. Rossin, Plastics Div., Monsanto Chemical Co., Springfield, Mass. The second paper was entitled, "Uses of Sodium Aluminate in the Paper Industry," and was given by Harvey E. Berg, National Aluminate Corp., Chicago, Ill.

On Saturday morning, Oct. 8, a mill visit was made to the Rising Paper Co., Housatonic, Mass.

On Friday night, a banquet was held at which time the presentation of a desk set was made by Gordon L. Benson, chairman of the section, to Frederic S. Klein, Jr., past chairman. The gift was awarded to Mr. Klein in appreciation of the tremendous personal effort with which he motivated the section and which has built the section up to its present high status.

The usual ladies' program and social program was held, consisting of a Monte Carlo party on Friday night and dancing on Saturday night.

R. W. Ramsell, *Secretary-Treasurer*

Empire State (Western District)

The Lockport Felt Co. conducted guided tours through its Newfane, N. Y., plant the afternoon of Oct. 5, 1955, preceding the first meeting of the 1955–56 season of the Western District of the Empire State Section of TAPPI. Many of Western District's members and friends took advantage of this opportunity to observe first-hand the manufacture of wet felts for paper-making.

G. L. Benson, present chairman of the New England Section, presenting a desk set to F. S. Klein, Jr., past chairman

The evening dinner-meeting, held at the Park Hotel, Lockport, N. Y., was highlighted by a talk by F. P. Heil, Lockport Felt Co.'s supervisor of design, who discussed "Modern Trends in the Manufacture of Wet Felts."

O. E. Anderson, Jr., *Publicity Chairman*

Modern Trends in the Manufacture of Wet Felts

Frederick P. Heil

The subject of this paper could also be titled "Modern Trends in the Manufacture of Paper." As the modern techniques of the papermakers change so the felt makers must change and improve their techniques to keep up with the parade. Frankly, it keeps us stepping! The old cliche "One doesn't have to be nuts to be a papermaker but it helps" applies just as aptly to the felt makers.

The whole picture revolves around the papermaker's drive to cut his cost per unit of production. With increasing cost of labor, raw materials, capital investment, taxes, etc., as opposed to keener competition, this drive becomes more intense in an ever-increasing crescendo.

The cost of wet felts per ton of production hasn't escaped the eye of the man with the pencil by any means. In fact, we sometimes think we're being picked on. The present-day cost-conscious paper mill superintendent is well aware of the cost of his wet felts and is doing everything in his power to reduce it.

Some of the larger paper mills have even set up separate departments, whose duties consist of keeping track of the clothing and the maintenance of the paper machine. The heads of these departments are usually technically trained young men with a desire to do a job and prove the value of such a department. As a result, clothing cost has been reduced substantially within these mills.

The end result of all these cost cutting programs is keener competition among the felt makers to improve the performance of their felts.

To improve this performance the felt makers have had to make the following important steps: (1) new machinery, (2) more technical assistance, (3) more quality control, (4) coordination with customers, (5) improved felt design, (6) greater use of synthetic fibers, and (7) improved chemical treatments.

NEW MACHINERY

Today new machinery is very costly *but* a first-class product cannot be manufactured without first-class equipment. Wet felts are no exception!

We understand this and have taken positive action to secure modern equipment to furnish quality felts. Our replacement program has been in high gear since 1946.

Those of you who visited our plant this afternoon had the opportunity to observe the efforts Lockport is making to secure and maintain first-class equipment in order to manufacture a quality felt. We have rapidly replaced older obsolete equipment with modern machinery that will do the job better and more economically. Our new wool-scouring machine is a prime example of this type of replacement.

At the same time we have installed machinery that is new to the felt industry. For example, our worsted equipment is unique in that we are the only felt makers to manufacture our own worsted. We feel that we can make our own worsted more economically and with better control of its quality than by buying this type of yarn on the open market.

In addition, due to the papermakers trend toward wider machines, we have installed equipment to take care of this

Frederick P. Heil, Supervisor of Design, Lockport Felt Co., Newfane, N. Y.

extra width. Our new felt drier is the most modern in the world and will handle the felt of the future with ease.

Our Starkville, Miss., plant is now starting operations. This plant is the most modern in the world and is fully equipped to produce a quality felt which will result in better vice to all mills.

Regardless of the expense, the papermakers can be assured that the felt industry is prepared to invest in the equipment to furnish a quality felt in any size required.

TECHNICAL ASSISTANCE

Technical assistance has become of increasing importance to the felt makers. The felt makers need it and the papermakers demand it.

We feel that technical assistance is divided into two parts—service and trouble shooting.

Service

From a designer's viewpoint, there can't be too much service work. Above all we want to know our tolerances! No felt is consistently perfect but if it is within its tolerances no trouble will be encountered. The gimmick is "What are these tolerances?" Their determination is one of the most important jobs the service man can perform. Actually, it can be likened to "preventive maintenance" applied to felt making.

By observing successful felts on the machine, its running sizes, its drainage characteristics, the operators' comments as to finish, and other operating characteristics, over a period of time enough experience will be gathered so that these tolerances can be ascertained. Once these are assimilated, the felt can be designed to try and ride a middle course so that any minor variation won't land both the papermaker and the felt maker right smack into a lot of trouble.

Within this field, surveys of new positions by trained felt engineers are almost mandatory in this day and age. At Lockport, we try to follow this procedure wherever possible in order to ensure that the felt designers have all available information. Sometimes, on particularly knotty problems, our felt designers are present at these surveys themselves so that they can obtain firsthand the objectives of the papermaker. It is a good and logical procedure and it pays off.

Along the same line, with particularly difficult positions, we try to have a service man there some time during the life of this felt in order to obtain a more accurate picture of the performance of the initial felt.

Trouble Shooting

This field is one that the felt makers would like to eliminate. However, none of us makes perfect felts nor has the perfect paper machine been developed or maintained.

Most felt makers are rapidly expanding their service department to take care of trouble shooting. As all you bridge fans know "a peek in the hand is worth two finesses." The felt makers feel that a service man on the job when a felt is in trouble is worth a dozen reports a month later when the details have become stale with time.

We find in innumerous cases that when we try to handle complaints by letter or phone, we can get a distorted picture as to the trouble For example, one has to be sure of the correct terminology. The felt maker might think his felt is short and find out that the papermaker meant it had poor drainage when he said it was tight. Strangely enough, a felt mark is another very confusing complaint depending on the type of paper being made. It can range all the way from crushing to shell mark. A felt maker has to be very sure of his ground with this complaint. We feel the best way to get a clear picture of the trouble is to have a competent service man there some time during the life of the felt.

Along these lines we maintain company airplanes that are ready to transport our service representatives to all sections of the country. These planes aid materially in having a man present in a very short time after receipt of a complaint.

More Quality Control

With all of the felt experimentation that has been going on over the last decade, the papermakers still demand a dependable felt.

A dependable felt requires the correct design which must be manufactured to the correct specifications. This can only be achieved consistently by having excellent quality control.

The papermakers are well aware of the importance of quality control with their own products. As a result they can appreciate the necessity of having it in the manufacture of felts.

Felt making is still pretty much of an art but the felt makers are working hard to reduce it to a science through their quality control departments. The felt makers can't very well cut a piece out of the finished felt to check the specifications but they can control their component parts and thus the finished product. However, only the paper machine can really tell how successful the felt maker's quality control has been.

Closer Coordination with Customers

In spite of the service department every felt can't be handled exactly as the felt makers desire, so, at times they are dependent on the papermaker's word as to the performance of their felts.

At Lockport, we make every effort to work as close to the papermaker as possible. Our salesmen are instructed to keep a running tab on all felts and if there is any sign of trouble, or possible change in machine operation, to advise our service department at once. At the same time, they work as closely as possible with the paper mill superintendent in order to keep his inventory at an adequate but minimum level.

In addition, we try to keep our customers informed as to any changes in their felts so that the responsible parties can keep an eye on these felts. By doing so, we obtain a report on these felts that will be much more reliable than by trusting to luck.

No information at all is preferable to the wrong information. So, whatever the cost, reliable information is worth it in the long run.

IMPROVED FELT DESIGN

So far we have discussed the importance of new machinery, technical assistance, and customer coordination. At this point some mention should be made of felt design.

In spite of the use of synthetics, treatments, and the resultant publicity, the felt design is still the backbone of the felt. No amount of synthetics or treatments will correct a poor felt design.

The life of the felt designer hasn't been particularly easy during the last decade. He has had to adjust his designs to cope with the problems arising in the felt mill due to the use of synthetics and treatments and, in addition, he has had to keep up with the changes going on in the paper mills.

In the paper mills the papermakers have been increasing their speed steadily and this change has had to be compensated for in design. In addition the vacuum transfer press, as well as the hot press, has also entered the picture with their attendant problems.

As you well know finish is also a changing thing which must have its affect on felt designs. During World War II, most anything was good enough. After the war, finish again became critical. Along came Korea and drainage and production became the cry. Now, finish has returned to haunt us again.

There has been a certain amount of experimentation with

new weaves within the last 5 years. The results have been varied but sufficient interest has been aroused so that, over a period of time, they will probably be assimilated and become part of the standard felt weaves.

As a result of all the experimentation, there has been a constant change in felt designs. The old days when a felt design for a given position remained the same for years certainly is a rarity in this day and age.

However, progress can only be achieved by change and woebetide the felt mill that doesn't progress.

SYNTHETICS

As you know, the use of synthetics in felts is hardly new. Nylon has been the most common fiber and has been used in ever-increasing quantities since the end of World War II. However, for the most part, this fiber has been restricted to use in filling yarns to increase the abrasion resistance of these yarns. At present, this type of use is almost as common as 100% all wool felts.

During the last 5 years Dacron has entered the field and is now being used extensively. This fiber is finding its greatest use in the warp of felts where its stretch characteristics are more desirable than those of nylon. This is especially true of cylinder bottom and wet machine felts. Varying blends have been tried from 10% to as high as 50% depending on the requirements of the paper machine. Thus far we have had the most success with approximately 25% synthetics.

However, felt requirements vary so greatly there seems to be no one blend that is optimum for all machines. The "trial and as little error as possible" method still prevails. One thing certain, the results of these felts are consistently favorable enough to tell us that this type of felt is here to stay.

TREATMENTS

Chemical treatments is another field in which the felt makers are trying to improve their product in order to better serve the papermakers.

Chemical treatments in themselves are nothing new as they have been on the market for the last 25 to 30 years. However, new ones are constantly being developed and much greater emphasis is being placed on them than formerly. This is especially true during this last decade.

Antibacterial treatments are possessed by most felt makers and are used where desired. Some times they are of service, other times it is debatable if they are doing the job required of them. Some times this might be due to incorrect analysis of the problem itself. For example, no antibacterial treatment will correct faulty roll alignment on the paper machine, or some other mechanical defect.

At Lockport, we have a mothproofing treatment that we are quite proud of. This treatment eliminates the use of the standard naphthalene or paradichlorobenzene. The beauty of it is that of its nonvolatility and as a result, no replenishment of it is needed unless the felt has been wet out.

All the felt makers, as well as Lockport, are working industriously on treatments that will aid their felts in better resisting chemical and mechanical damage. This is a very broad field and I suspect the year 2000 will witness our grandchildren working industriously on refinements of the same problems. However, there is a tremendous amount of research being put into it and you have all been exposed to some of the results of these programs.

CONCLUSION

We have discussed the steps that the felt industry is taking to improve their products and we feel that the felt makers have made significant strides.

However, if the papermaker is sincere in his desire for improved felt operation, he must be willing to do his part in regular and adequate maintenance of the paper machine.

The felt makers will continue to do their part regardless but significantly lower felt cost will be achieved only by the cooperative efforts of both parties. We are confident that this cooperation will be available.

PRESENTED at the meeting of the Western District of the Empire State Section of TAPPI, Lockport, N. Y., Oct. 5, 1955.

Empire State (Northern District)

The Northern District, Empire State Section of TAPPI, met at 7:30 p.m. on October 13 at the Newton Falls Hotel, Newton Falls, N. Y. In the afternoon, members of the group toward the Newton Falls Paper Mill and also the Jones & Laughlin Steel Corp. mining operation at Benson Mines. One hundred and twenty-five were present at the dinner, 70 visited the paper mill, and 80 visited the mine.

The Newton Falls Paper Mill is one of the most highly instrumented mills in the country and proved very interesting to all who saw it. Features of the plant, which manufactures book grade papers from high quality wastepapers and purchased pulps, include automatic drier control on both paper machines and both coaters, automatic pH control on both paper machines, beta-ray gages measuring basis weight on both machines, automatic jordan plug pressure control, program controllers on starch cookers for enzyme conversion, Roto-belts on paper machines for improving wire life, Bauer cleaners for dirt removal, and many other indicating instruments for temperature, pressure, and level.

At Benson Mines, the group saw the open pit mining, crushing, and separation operations. This location is one of the largest open-pit mines of low grade ores in the country.

Following the mill and mine visits, the group was entertained through the courtesy of R. W. Hynes, president and general manager of the Newton Falls Paper Mill.

After dinner, the program consisted of talks by members of the Newton Falls mill staff. J. Wayne Morrow, paper mill superintendent, discussed "Recent Innovations in Newton Falls Papermaking Equipment," M. M. Nolan, coating plant superintendent, gave a talk on "operation of the Waldron Coater at Newton Falls," and A. A. Wagner, instrument engineer, spoke on "The Possibilities of Future Instrumentation in the Modern Paper Mill."

(Miss) ELIZABETH L. CASE, *Secretary*

Empire State (Eastern District)

This meeting was a conducted tour through the plant of the Allegheny-Ludlum Steel plant in Watervliet, N. Y., with particular emphasis placed on the company's foundries extrusion and cold-draw departments.

Following the tour, members adjourned to the Circle Inn, for dinner followed by talks given by officials of the steel firm.

The business meeting was called to order at 8:25 by the chairman, Earl Johnson. Mr. Johnson introduced the members of this year's executive committee. Talmadge Edman, program chairman, announced that D. G. Currie, vice-president in charge of manufacturing of the E. B. Eddy Co. will be our speaker at the November 17th meeting to be held at the Queensbury Hotel, Glens Falls, N. Y.

The treasurer reported a balance on hand of $202.45.

Mr. Ralph Prince was introduced and spoke briefly on membership. Reports by various committee chairmen followed.

Talmadge Edman, program chairman, introduced Gilbert Henke, manager of the extrusion and cold draw departments who presented the program of the evening. Mr. Henke introduced Frederick Philip (metallurgist) who spoke on the stainless steel alloy's and their resistance to corrosion. This was followed by a question-and-answer period. Mr. Henke then introduced Anthony Graae, assistant to Mr. Henke in charge of extrusion, who spoke on the development of the

extrusion press in forming tubing and various shapes and cold-drawn work. Another question-and-answer period followed Mr. Graae's talk.

Eighty members and guests of the Allegheny-Ludlum Steel Corp. attended this meeting.

C. T. McGREEN, *Secretary*

Empire State (Central District)

The Central District of Empire State Section of TAPPI met at 7:00 p.m., Oct. 7, 1955, for its monthly dinner meeting. There were 102 in attendance.

Chairman Durward B. Geffken called the meeting to order and introduced those seated at the head table. They included A. L. Ahlers, Mengel Corp.; B. H. Wortley, secretary; F. W. Sommerville, Lewis Cutter; William Holl, vice-chairman; William Trimble, manager of Robert Gair, Syracuse; and S. E. Church, treasurer. Mr. Geffken also introduced Prof. F. W. O'Neil and his guest, Mr. Sommerfield from Australia.

Mr. Holl introduced the speaker of the evening, Lewis Cutter, assistant sales manager for the Container Corp. of America, Philadelphia, Pa.

Mr. Cutter began with a review of dates and records of the corrugating industry. The history of fluted material was traced back to that first used as sweat bands for men's hats.

The construction and operation of the corrugator were then outlined. The four things which cause the corrugated box manufacturer the most trouble are:

1. Moisture variation across the web.
2. Caliper variation across the roll.
3. Formation of the liner (a well knit sheet of soft fiber gives the best print surface).
4. Smoothness of liner for good printing (wire and felt marks are sometimes hard to conceal).

Some of the refinements being used or tried today are:

1. A means of getting more heat.
2. A two-viscosity starch.
3. Heat-resistant yarn woven into cotton felts for carrying over the hot plate for longer wear.
4. Wipers or scrapers on transfer rolls.
5. Chrome plating of corrugating rolls for greater life.
6. Hydraulically loaded pressure rolls.
7. Color coating done at corrugator.
8. Resin application.
9. Both tape and string added at corrugator for easy opening.
10. Yarn added to strengthen girth of box.

The future holds the key to many new developments in the corrugating industry such as:

Left to right: S. E. Church, D. B. Geffken, B. H. Wortley, Wm. Holl, and Lewis Cutter at the Central District meeting

1. IBM machines for determining the best combinations of orders for runs.
2. Adhesives which do not require heat.
3. Push button control, complete on one board.
4. Improved slitters, and many more.

An interesting question-and-answer period followed Mr. Cutter's talk. A few of them are:

Q. Why it is necessary to use asphalt tapes?
A. It is not necessary—glass fiber tapes are also very popular now.
Q. With improvements in surface smoothness for better printability, do you not also encounter increased slipping in piling?
A. Yes, slipping is much more pronounced. Kraft is not so bad as jute.
Q. Are you giving increased friction to prevent this slipping?
A. Sometimes the surface is actually knurled. Also, the ink companies make claims for nonslip ink.
Q. Is there a trend to four-color printing on brown kraft or coated boxboard?
A. The printing plates for two-color run about $200. For four-color, $1300. In the box field these prices seem very high.
Q. Has there been any attempt to use infrared to dry glue liner?
A. It has been talked about, but there is no known installation. Robert Gair and MIT made a survey and found it too expensive for 20–30 years.

(MRS.) BARBARA H. WORTLEY, *Secretary*

LETTERS TO THE EDITOR

B.O.D. from Oxygen-Consumed Determinations

To the Editor, *Tappi:*

An interesting article by H. F. Berger on "B.O.D. from Oxygen-Consumed Determinations" has appeared in a recent issue of *Tappi* (38: 534 (1955)). Unfortunately, the statistical methods used by the author to evaluate his experimental data contain errors of method as well as of arithmetic; his data are in fact better than he himself believes. His results not only do not disagree but are actually in excellent agreement with the data of Chesley, White, and Hogg (*Tappi* 34: 86 (1951)) whose calculations also contain arithmetical errors.

The methodical error is in the statement following equation (2) on page 534:

The terms $(\Sigma X \Sigma Y)/N$ and $(\Sigma X)^2/N$ must not be neglected if their ratio is of the order of 1.0, for this would be equivalent to cancelling b and d from the ratio $(a - b)/(c - d)$ if $b/d \approx 1.0$. They can only be neglected if their ratio is of the order of a/c (i.e., $\Sigma XY/\Sigma X^2$) but this, too, is bad policy, because intuition is then the only guide, while actually an exact statistical test is available.

Analysis of variance may be used to test the significance of the two regression lines, to compute the residual sums of squares and variances about the lines, and to test whether the line through the origin or the line with an intercept gives the better fit to the observed data.

If Berger's results are corrected for arithmetical error ($\Sigma X = 44551$, $\bar{X} = 450.01$) equations (6) and (7) of his paper should read

$$\bar{Y}_x = 293.84 + 0.5585(X - 450.01)$$

$$\bar{Y}_x = 0.5585X + 42.51$$

Equation (8) for the line through the origin is correct.

Analysis of variance of the two regression lines leads to this result:

Line with intercept			
Variability.....	d.o.f.	Sum of squares	Mean square
Due to line.....	1	725,402.696	725,402.696
About the line...	97	252,600.719	2,604.337
Total.....	98	978,023.415	...

Line without intercept			
Variability.....	d.o.f.	Sum of squares	Mean square
Due to line.....	1	9,254,569.705	9,254,569.705
About the line...	98	271,212.295	2,767.472
Total.....	99	9,525,782.000	...

The improvement (reduction) in the residual sum of squares about the line due to using an intercept is given by the difference (= 18,591.576) and the statistical significance of this difference may be tested against the residual variance (= 2,604.337) by means of Fisher's F-table with 1 and 97 degrees of freedom. Here $F = 7.14$, while the critical value of F at the 1% significance level is about 6.9.

It must, therefore, be assumed with 99% confidence that the line with intercept gives the better fit, and that the intercept represents a real effect and is not due to random fluctuations in the experimental data. The reason for this may be some bias in the method, requiring a blank, or it may simply mean that the results must not be extrapolated as far as the origin.

When the results of Berger's calculations were compared with similar data obtained by Chesley, White, and Hogg, it was found that an arithmetical error had also crept into their calculations. The equation of their regression line is recalculated to be

$$Y = 0.5088X + 57.48$$

To see whether this equation and Berger's corrected equation (7) differ significantly, analysis of covariance may be employed.

Analysis of covariance shows that neither the variances, nor the slopes, nor the intercepts of the two regression lines differ significantly at the 95% confidence level. It is, therefore, suggested that the results of the two investigations may profitably be pooled to yield a single regression line of higher accuracy.

The equation derived from the pooled data is

$$Y = 0.5457X + 47.482$$

and analysis shows that the intercept is significantly different from zero and must not be neglected.

The standard deviation of a single observation from the pooled regression line is

$$s = \pm 47.6 \text{ p.p.m.}$$

and confidence limits at any desired significance levels may be calculated by multiplying s with the appropriate Student's t for 151 degrees of freedom.

An examination of the data in Berger's Table II shows that for the case of the treated effluent a straight line through the origin will give the better fit to the experimental data. The equation of this regression line is

$$Y = 0.096{,}252X$$

and the standard deviation of single observation from the line is ±7.2 p.p.m.

This also shows the fallacy of averaging X/Y to obtain a regression coefficient.

While it is true that oxygen-consumed is not a universal test for the 5-day B.O.D., excellent and consistent results have been obtained by Mr. Berger and others where the biologically unavailable oxygen is relatively constant. It is to be expected under these circumstances that the correlation lines for different sewage materials or river waters will have different slopes and intercepts depending on the ratio of biologically available to biologically unavailable material.

Mr. Berger's data for total mill effluent are in excellent agreement with the data of Chesley, White, and Hogg, and may be pooled with them to give the equation

$$\text{5-day B.O.D.} = 0.5457(\text{O.C.}) + 47.482$$

The standard deviation of a single observation from the regression line is 47.6 p.p.m. Since interest usually centers on the one-sided probability that the B.O.D. be not higher than a certain specified value, we may say, e.g., with 95% confidence, that the true B.O.D. of the total mill effluent will not be more than 78.5 p.p.m. higher than the result calculated from the O.C. test.

Similarly, the results on the treated effluent from the pilot plant show a highly significant correlation

$$\text{5-day B.O.D.} = 0.09625(\text{O.C.})$$

with a standard deviation of 7.2 p.p.m. Again, it may be assumed with 95% confidence that the true B.O.D. will not be more than 11.9 p.p.m. higher than the value calculated from the O.C.

It is, of course, to be expected that the data of Table III of Berger's paper, where the entries are differences, should show larger variations than the two previous examples. However, they should not simply be disregarded, after all it is the purpose of statistics to extract useful information from such data.

Thomas W. Bauer
Abitibi Power & Paper Co., Ltd.
Sault Ste. Marie, Ont.

Guide to Career Opportunities

To the Editor, *Tappi:*

I have just looked over the booklet titled "A Guide to Career Opportunities in the Paper Industry" issued by the American Paper & Pulp Association and would like to suggest that the opportunities offered at the University of Washington are not adequately described on page 17.

The University here has for many years offered university training in science and engineering leading to the degrees of Bachelors, Masters, and Doctors, especially in chemical engineering and chemistry. Many graduates of the University of Washington over the last 50 years have found places for service in the pulp and paper industry in the Pacific Northwest and elsewhere throughout the country. The university here has courses of lectures with subject matter of rather direct interest in pulp and papermaking and these lectures are available to students in both the Undergraduate and the Graduate Schools of the University of Washington.

Research relating to pulp and paper from a broad point of view has been in progress here at the University of Washington for perhaps 40 years and many a thesis and also papers have been published from the results of this work. Therefore one can say that adequate research facilities are available here at the university for broad research investigations and in particular I should like to point out that funds have been made available for Research Fellowships by Rayonier, Inc., and others which aid a graduate student financially in carrying out work for his doctor's degree and at the same time support research in the fields of cellulose, lignin, and other aspects of wood chemistry. Over the last 10 years or so the Pulp Mills Waste Research Project has been carried forward at the University of Washington for development of knowledge of and uses for pulp and paper mill wastes and nearly half a million dollars has been expended in this program.

I am surprised that on page 17 no mention is made of the University of Washington among the institutions and organizations engaged in basic research. I expect that nearly 50 research papers have been published in the last 10 years from

this university describing the results of basic research investigations related to some extent to the pulp and paper industry.

JOSEPH L. MCCARTHY, *Professor*
Department of Chemistry
University of Washington
Seattle, Wash.

WVP Cups

To the Editor, *Tappi:*

I am interested in knowing the names of the suppliers of water vapor permeability test cups, as described in the TAPPI Standards, which we recently received.

The two test methods using these test cups are as follows:

"Water Vapor Permeability of Paper and Paperboard; Test Method T 448 m-49"
"Water Vapor Permeability of Sheet Materials at High Temperature and Humidity; T 464 m-45"

C. I. HENSEN,
Technical Staff, Pierce & Stevens, Ave., Buffalo, N. Y.

To the Editor, *Tappi:*

In reference to the name of a supplier of water vapor permeability test cups, these are available from The Package Materials Laboratories, Inc., 461 Crescent Rd., Hatboro, Pa., and Thwing-Albert Instrument Co., Penn & Pulaski Sts., Philadelphia, Pa.

A. J. WINCHESTER,
Tappi, New York, N. Y.

RECENT BOOKS

Hydrogen Peroxide. By Walter C. Schumb, Charles N. Satterfield, and Ralph L. Wentworth, Massachusetts Institute of Technology. Reinhold Publishing Co., New York, 1955. Cloth, 6 × 9, 759 pages. $16.50.

ACS Monograph No. 128 is a critical and up-to-date treatment of the manufacture, properties, technology, and uses of hydrogen peroxide. More than 2500 literature references are given.

Beyond its industrial use, hydrogen peroxide has long been of concern to chemists because of the unusual characteristics of the peroxide bond. Its unique position as the oxidation-reduction intermediate between oxygen and water accounts for its formation in a wide variety of reactions.

The book like the other ACS monograph is a comprehensive treatise of the subject. It covers the history, technical developments, literature, methods of manufacture, concentration, handling, properties, stabilization, analytical procedures, and uses. There is an excellent section on wood pulp bleaching and paper deinking.

The Automatic Factory—A Critical Examination. By S. A. June, J. D. Bardis, and others. Instruments Publishing Co., Pittsburgh, 1955. Cloth, 5 × 8, 88 pages. $1.50.

This book is a joint report by seven candidates for an M.B.A. degree. It represents their travels and investigations in a recent six-month period. It attempts to bridge the gap between theoretical concepts and actual industrial developments of the automatic factory. In addition to a bibliography of books and articles, it deals with mechanization, obstacles to the automatic factory, costs, and social implications. Several case studies are given.

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E321-55. Technical Man, 31, B.S. in Chemical Engineering, 7 years' combined laboratory and practical experience in paper industry, fourdrinier and cylinder machines, variety of grades. Now employed in production supervision. Ready to specialize in any one phase of industry—quality control, development, research, technical service, liaison work where my background can be well applied in a professional position. Ability and interest in writing.

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E323-55. Engineer. 25 years' experience in the pulp and paper industry includes mill design, mill modernization and expansion, process development, instrumentation and control, plant engineering, supervision of erection of equipment, seeks new connection where his knowledge, broad background, and abilities will be of value. Works harmoniously with others. At present employed. New York City preferred.

POSITIONS OPEN

P479–55. TAPPI Staff technical service man to assist Association Secretary. At least five years' experience in operating, engineering, or technical department of a pulp and paper company desirable. Must be industrious, enthusiastic, and able to get along well with people. Ability and interest in writing needed. Considerable travel involved. Broad interest in the many branches of the industry important. Give résumé of education and experience and statement indicating in what ways you feel that you can be of best service to the Association as an employee. State salary expected.

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Group Leader for Forest Products Section in new Research Center. Ph.D. or equivalent in wood technology or paper and pulp practice necessary. Strong background in chemistry and understanding of polymeric materials desirable. Excellent growth potential with a new division of an old and reliable company. Group is being newly formed and will concern itself with basic approaches to the over-all field of forest products. Reply in confidence enclosing complete résumé to P515-55.

The Bordon Co.
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Position open in research on the chemical modification and processing of wood. Location suburban Pittsburgh, Pa. Central Research Laboratories of company which is leader in the field of wood treatment. Salary commensurate with education and experience. Send complete résumé of education, experience, references, and salary desired. Reply to P516-55, TAPPI, 155 E. 44th St., New York 17, N. Y.

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Immediate opening in research and development department of specialty paper manufacturer. Excellent opportunity for young man with initiative and imagination. Experience or background in paper technology, electrical insulation, and resins desirable but not essential. In first letter give complete résumé of experience, education, and present salary. Address Personnel Director, Hollingsworth & Vose Co., East Walpole, Mass.

GRADUATE CHEMIST or CHEMICAL ENGINEER

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P505–55. Chemist or chemical engineer with experience in pulp and paper mill or pulp paper laboratory. Opening for a project chemist in Northwest integrated mill.

P509–55. Sales–Service Man Wanted. Established chemical company wants man with good paper mill or boxboard background for technical sales to board mills and corrugated board plants in central south. Good opportunity to expand established territory. Preferred age 25–35. Write TAPPI, P509-55, 155 East 44th St., New York 17, N. Y.

P513-55. Technical Sales Representative. Position open with nationally known chemical manufacturer for graduate chemist or chemical engineer with at least two years' paper mill experience. Age 26–34. Résumé of experience and education to be submitted as basis for personal interview.

P514-55. Chemical Engineer. Experience and thorough familiarity with paper mill equipment and process required. Line position on quality, control, process, etc. Pennsylvania location, with excellent growth potential. Give personal and work history, and income requirement in reply.

P517-55. Chemical Engineer—for research and development department of a midwest firm interested in paper container development. Applicant should be a graduate of a recognized university, age 23–35, previous experience desired but not necessary. Reply with full details of education, experience, salary expected. All replies confidential.

P518-55. Paper Chemist, with paper mill experience, graduate of a university specializing in paper curriculum preferred, desired for laboratory of national organization serving paper industry. Work includes research and development work on specialty products such as beater additives, sizes, coatings. Reply with full details of education, experience, salary requirements. All replies confidential.

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P520-55. Chemist or Chemical Engineer. Recent graduate wanted for work in a comparatively new plastic coated paper container division of a large Northeastern paper converting company. In reply state age, education, experience, and desired salary.

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A15-55. Institute of Paper Chemistry. Bulletin: Library Notes, 1930 to date. Want complete or broken set. Bound or unbound. West Virginia Pulp & Paper Co., Information Services Center, Charleston, S. C.

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Forty-First Annual Meeting, Commodore Hotel, New York, N. Y., February 20–23, 1956.

Seventh Coating Conference, Benjamin Franklin Hotel, Philadelphia, Pa., May 7–9, 1956.

Eleventh Engineering Conference, Sheraton Plaza Hotel, Boston, Mass., October 8–11, 1956.

Sixth Corrugated Containers Conference, Statler Hotel, St. Louis, Mo., October 17–18, 1956.

Tenth Alkaline Pulping Conference, Jung Hotel, New Orleans, La., November 14–16, 1956.

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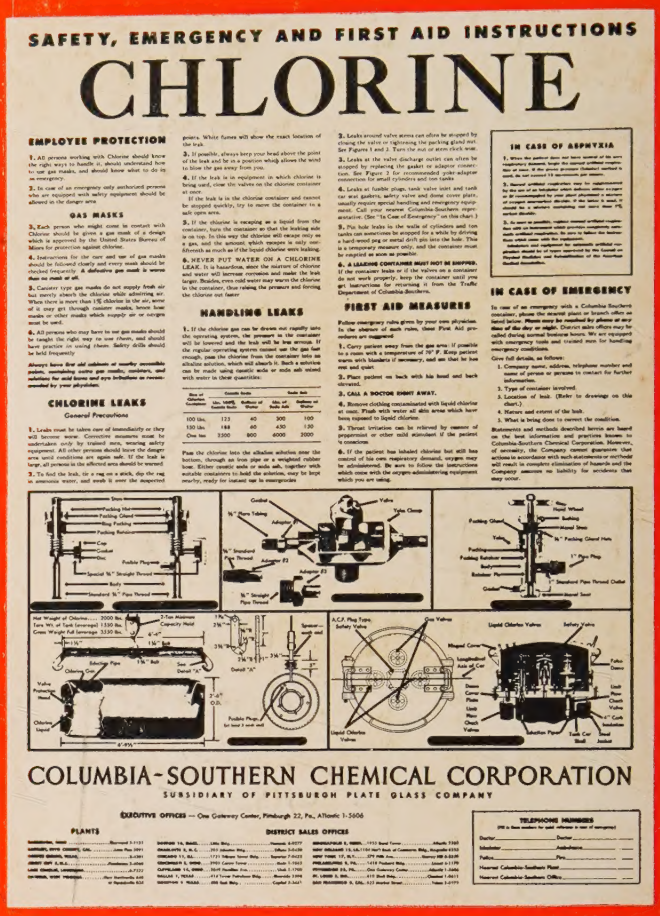
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